Standard Size, 9 x 12. OCTOBER 6, 1904. Price Ten Cents.

AMERICAN MACHINIST

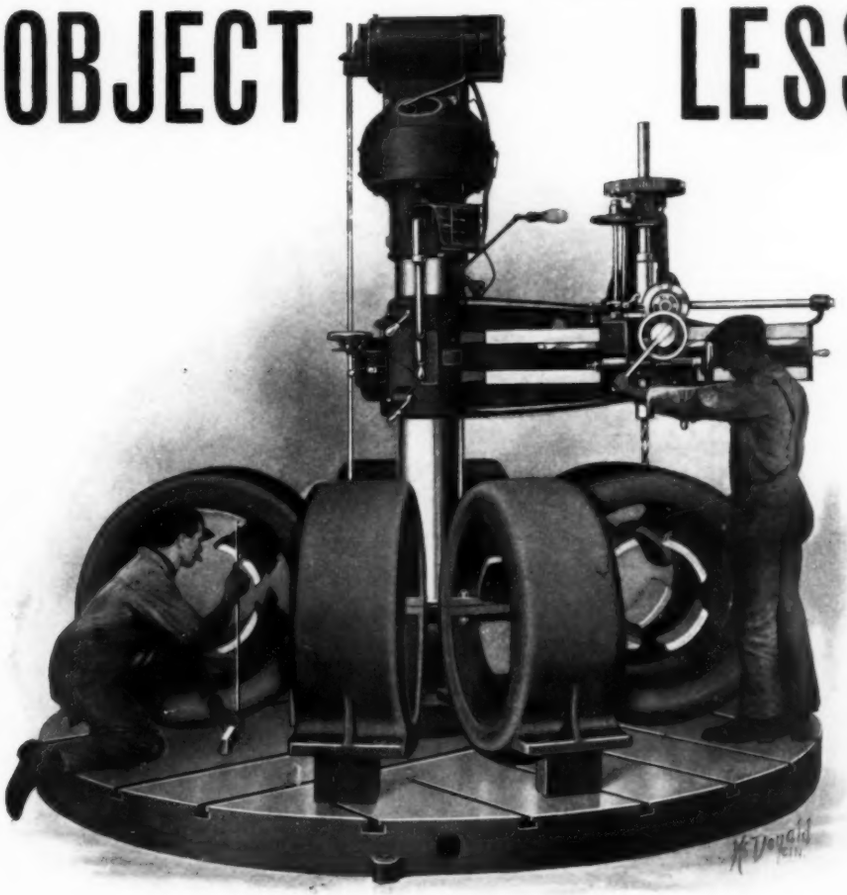
A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY.

Vol. 27. WORLD BUILDING, NEW YORK. No. 40.

Index to Advertisers and Classified Index Following Reading Matter.

AN OBJECT LESSON.



This cut shows one of several of our Improved Radial Drills fitted with round base drilling motor frames, at the plant of the Crocker-Wheeler Co., Ampere, N. J.

The saving claimed for the round base Drill is made on a class of work which comes in sufficiently large quantities to keep the Drill busy—one man laying out and a helper drilling; but which is not in sufficient amount nor of a nature to permit of applying jigs.

Under the above conditions, the work coming in sufficient quantities utilizes the whole of the round base, the drilling progresses in rotation—from which one can readily see the saving to be effected.

The accompanying cut shows but one of the many special style bases with which we fit our Radials. Our catalog which gives complete description of our various Drills, both standard and special, may be had for the asking.

THE BICKFORD DRILL & TOOL COMPANY,

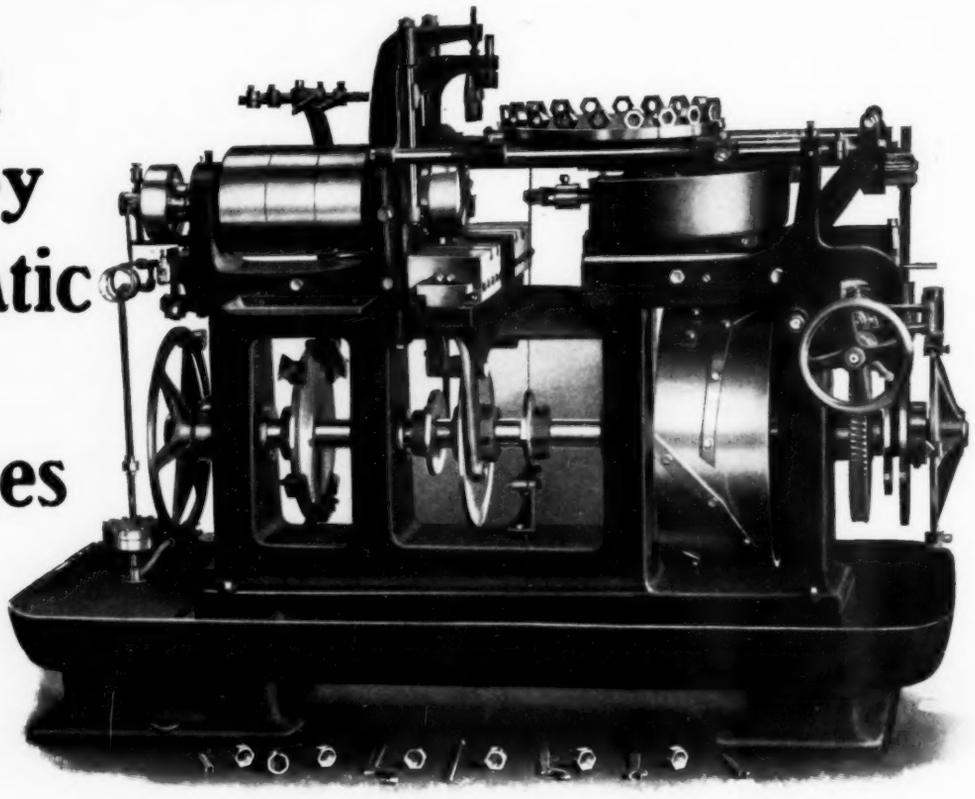
CINCINNATI, O., U. S. A.

FOREIGN AGENTS—Schuchardt & Schutte, Berlin, Vienna, Cologne, St. Petersburg, Brussels, Stockholm, Paris, Liege, Milan, Bilbao and New York. Charles Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. F. W. Horne, Yokohama, Japan. H. W. Petrie, Toronto, Canada. Williams & Wilson, Montreal, Canada.

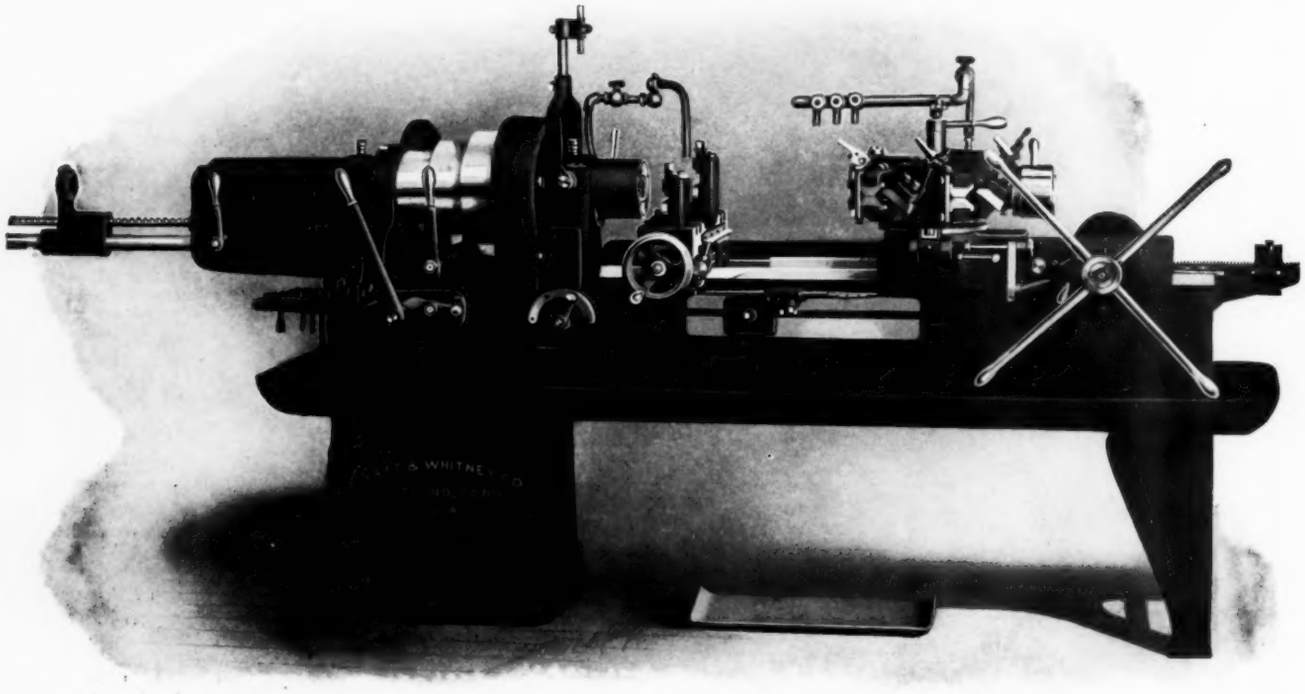
S. 1-A.

Pratt & Whitney Automatic Screw Machines

Many of the movements are performed by compressed air, making the machines very rapid.



Automatic Screw Machine, with Disk Magazine.



3 x 36 in. New Model Turret Lathe. Built in Five Sizes.

A particular feature of this machine is the chuck closing mechanism, which admits stock of $\frac{3}{32}$ over-size to $\frac{1}{32}$ under-size to be clamped with a uniform pressure.

Pratt & Whitney Co., 136-138 Liberty St., New York.
Works: Hartford, Conn., U.S.A.

OFFICES:

Boston: 144 Pearl St. Philadelphia: 21st and Callowhill Sts. Pittsburgh: Frick Bldg.
Chicago: 46 South Canal Street. St. Louis: 516 North 31 St. AGENTS: The Fairbanks Co., Montreal, Toronto, Winnipeg and Vancouver.

Compressed Air Power Transmission Plant of the Cleveland Stone Company.

A noteworthy installation of compressed-air machinery has recently been made at the North Amherst, Ohio, quarry of the Cleveland Stone Company by the Ingersoll-Sergeant Drill Company, and the following account of some of its leading features is abstracted from *Power* with, however, some additions:

Power is transmitted from a central compressing plant thru a system of air lines to various quarrying machines which are used in the operation of the largest sandstone quarry in the world, viz., the Gray Canon Quarry, Fig. 1, and to two neighboring quarries. The results which have been obtained since the introduction of compressed air are quite remarkable when compared to the performance when operated as a system of small isolated steam plants.

The plant consists of a central air compressing plant, from which power is transmitted to the various machines which were formerly operated by steam from small isolated boilers.

The two main units of the compressor plant are steam-driven cross-compound condensing two-stage Corliss air compressors, built by the Ingersoll-Sergeant Drill Company, of New York, shown in Fig. 2. The steam cylinders are 20 and 44 inches in diameter; air cylinders, 24¼ and 39¼ inches. The common stroke is 48 inches. At normal speed of 90 revolutions per minute, each compressor has a low-pressure piston displacement of 6,030 cubic feet of free air per minute, and at 100 pounds air pressure indicates about 1,000 horse-power.

The air valves—inlet and discharge—are of the Ingersoll positive air-thrown type, two inlet and two discharge valves being carried on each cylinder head. A piston on each valve stem within a small cylinder in the valve bonnet carries on one side standard air pressure, on the other a reduced pressure of about 1 pound. The lower pressure opens the valves at the proper time; the higher pressure holds them to their seats. The admission and release of high-pressure air to the valve cylinders is controlled by a small independent slide valve device operated thru a reducing motion from the main piston rod. There is no "chattering" of the valves, and indicator cards show none of the familiar irregularities in intake and discharge lines. The diagrams are practically ideal, as shown in Fig. 3, which reproduces cards from high- and low-pressure cylinders.

The vacuum drag on the low-pressure cylinder is in part due to drawing the air thru the water of a washer in order to remove the dust. A good part of this loss is, however, regained by the consequent reduction of the temperature of the air by from 12 to 17 degrees. The amount of dust collected by the washer is quite remarkable. Starting with clear water it becomes roily almost immediately and sediment soon begins to accumulate, "wheelbarrow loads being obtained where spoonfuls were expected."

The removal of the moisture entrained in the compressed air was one of the most vital problems to be solved, as dry air is one of the first requisites in expansive engines. The inter-coolers and after-coolers receive the first and second precipitations of entrained moisture and are regularly drained. The air header discharges into the primary receiver, 66 inches in diameter by 13 feet long, and here again moisture is accumulated and withdrawn thru the drain cock. From the primary receiver the air lines grade to secondary receivers. The lines beyond these secondaries are also laid to drain back to them. These secondary receivers catch any moisture which may have passed the earlier separators. In operation it has been found that the air delivered to the cylinders of the machines is remarkably dry.

The air pipe distributing system has been worked out to a fine degree of perfection and is worthy of special note. As the zone of activity in a large quarry is constantly shifting over a large area, the full power of the system, with a minimum investment for material and minimum liability to vital breakdown are the prime requisites of the system. The accompanying diagram, Fig. 4, shows how this problem has been solved. The air piping has been laid out in a five-loop system and a consideration of the diagram shows that the maximum volume of compressed air is available on any one of the lines without excessive drop in pressure, while any line or section can be cut out for repair or alteration without crippling any other part of the system. A short study of the diagram will show the flexibility of the layout, any point of the quarry being reached thru three or more pipes. For instance, any point in loop No. 4 may be supplied with air thru lines *AG*, *ABC*, *HJKL*, *HJKRQ*, *HJUTSQ* and *HJUTSRL*. Any one of these lines may be broken or cut out without crippling the loop or reducing the volume of air available.

The air lines are coupled by the Hammon gas pipe coupling, which has proved to be extremely tight and which allows of a deflection of the pipe of 15 degrees, so that it may conform to the contour of the ground over or thru which it is laid. This is illustrated in Fig. 5, which shows part of a run of 3,000 feet of 11½-inch pipe running to one of the adjacent quarries. Flange connections are necessary at branches and valves, but the Hammon joint is immediately reverted to. A section of the Hammon joint is shown in Fig. 6.

FIG. 1. ONE END OF GRAY CANON QUARRY.

The loop arrangement gives a great carrying capacity at low pipe cost. Expansion and contraction are provided for by offsetting the line one pipe length every 400 feet. These 400-foot sections are anchored at the middle; any variation in the length is taken up in the elasticity of the offset pipe, without strain to joints or fittings, the line being mounted on rollers at proper intervals. All the valves are of gate pattern and in sizes above 3 inches have rising stems, so that their position may be observed from a considerable distance. At intervals of 40 feet, 3-inch branch tees are inserted in all mains, for the attachment of branches to working faces. All main line loop tees are protected by valves in their three branches.

The air piping system was installed un-

der a guarantee to hold full working pressure for twelve hours and to stand the same test at the end of a year.* Air gages, accurately calibrated and interchanged, have shown no measurable drop in pressure at any point on the distributing system. The ample receiver and pipe capacity absorbs all fluctuations and the pressure maintained at the power-house is available at every working face.

Reheating is employed at hoist and mill engines and is being extended to all air motors. A very simple and effective stationary air reheater has been devised, consisting of a few turns of pipe laid in a brick setting and heated by a small coke fire. The average cost of each of these reheaters, in labor and material, has been $35. A surprisingly small quantity of coke is required, the cost of present application not exceeding $1 per day. The air is heated to 280 to 300 degrees Fahr., and no trouble has been found in lubrication of cylinders. On some of the channeling machines, the old boilers are temporarily retained and connected into the air line, serving as an air reheater by the use of a small coke fire on the partly covered grate. More compact and efficient reheaters are being devised to replace these boilers and for all cases where a portable device is required. No attempt is yet made to reheat the air for the drills.

A novelty in the distributing mains to two neighboring quarries to which connection has been made is the use of light casing with Hammon couplings instead of standard pipe. Natural gas transmission practise has been followed, at a cost for a given carrying capacity of about two-thirds that of a standard pipe line.

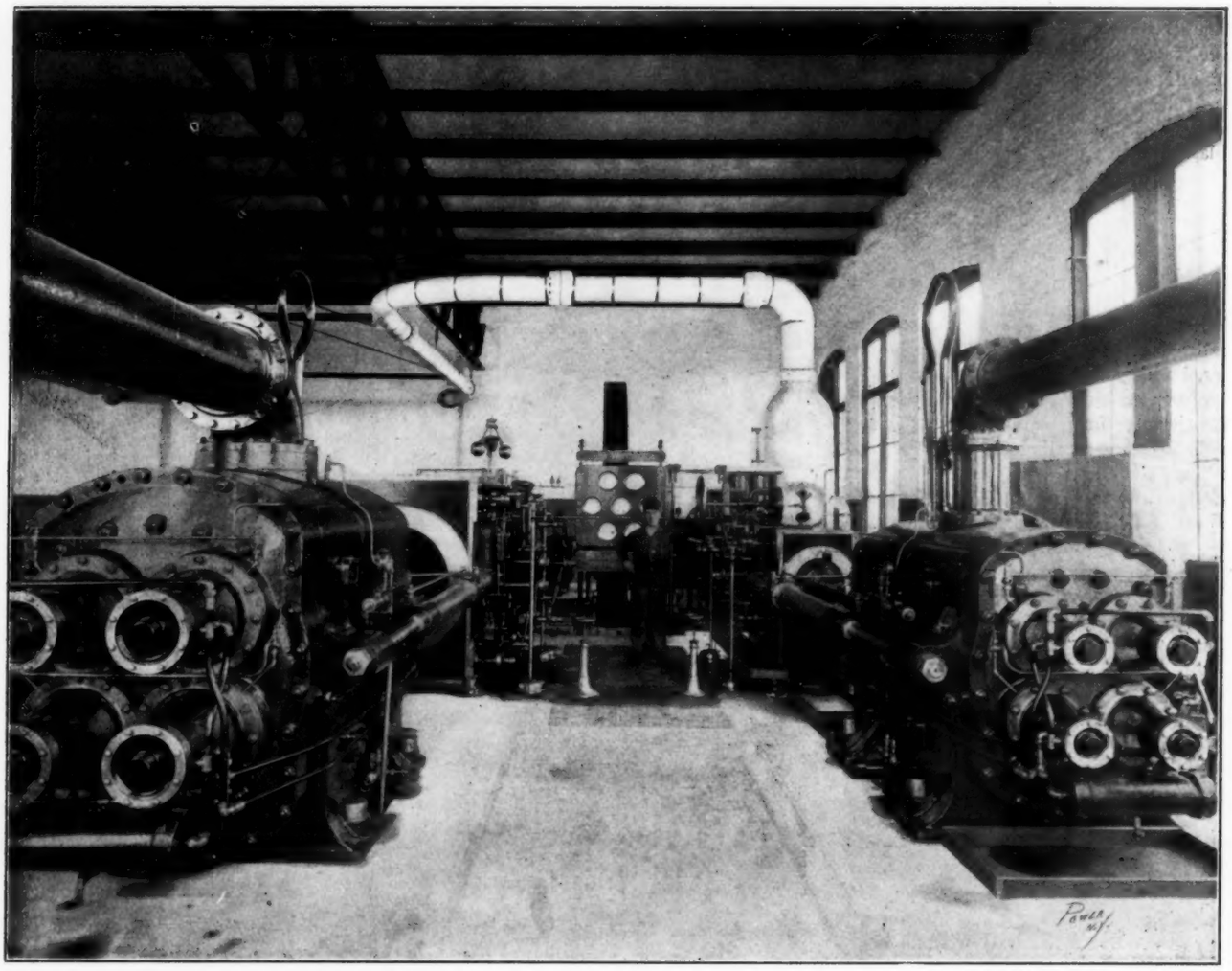


FIG. 2. A COMPRESSOR UNIT FROM THE AIR END.

One of the most interesting features of the installation described is the fact that no special appliances were introduced for the application of the new power. The machinery already operated by steam under the old system was simply overhauled, the cylinders rebored, rods turned, glands packed and clearance reduced and attached to the air lines. The cut-off on the expansive engines was in some cases shortened to 5/8.

Experiments now under way indicate that reheating may be carried to a much higher degree than has yet been attained. It is believed that temperatures as high as 500 to 700 degrees Fahr. may be used without attaining a mean cylinder temperature which will cause trouble in lubrication, and that in many cases the cut-off can be reduced to give terminal pressure at atmosphere. The installation of reheating devices has been gradual and is not yet complete.

From figures furnished by the chief engineer of the quarry, a total saving of $49,485 per year of 300 days is calculated. This great saving is one not wholly of savings in fuel, but is made up of several items, one of which is increased production with a smaller force of men.

This result is due to several causes, chief among which is, perhaps, the fact that a full working day of ten hours is secured under the most effective conditions. When work starts in the morning, the full working pressure is secured at the turn of the throttle and is maintained throughout the day. There is no delay at starting. There is no fluctuation in pressure due to careless boiler attendance; there is no labor employed in wheeling coal and in moving water barrels and pipe to keep pace with the movement of the channelers. There is no smoke and steam settling in the quarry, darkening it, mak-

*We can testify from personal observation to the remarkable tightness of this system of mains which, it should be remembered is, in the aggregate, several miles long. During an afternoon's observation just one blow was heard, and this was from the stuffing box of a gate valve.—Ed.

ing a short day shorter and interfering with rapid hoisting. There is no steam to wet the clothing of the men in cold weather, no smoke and heat to stifle them in warm weather. There is no condensed steam in the pipes and cylinders to be blown out before operations begin. There is no draining gang to empty the pipes at night, no thawing gang to open them in the morning. There is no time lost in banking fires or waiting for coal. Heavy air pressure, everywhere uniform, drives every machine to the limit.

Furthermore, the use of the new power has improved the character of the quarry output. Under the old system, with coal and ashes scattered over the working floors, the water from rain or snow found its way thru the coal or ash pile, over the surface and down the sides of the rock, staining and discoloring it. With smoke from the boilers filling the quarry, the exposed faces were quickly covered with a dark deposit. Since air has been used, these effects have disappeared, and the rock quarried presents a clean, sparkling surface.

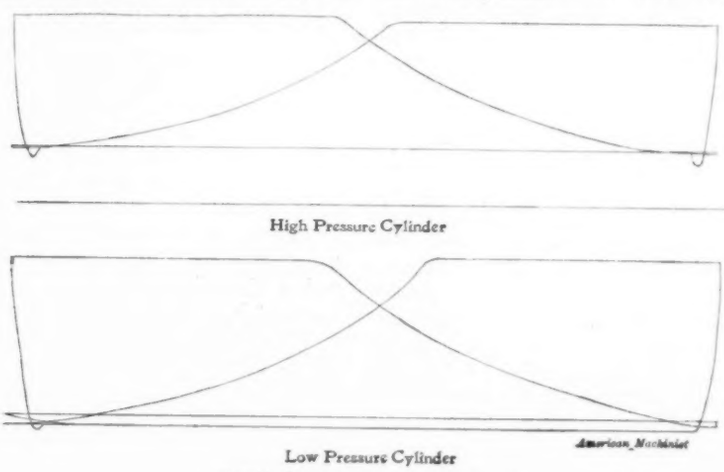
The introduction of compressed air has made conditions so pleasant that old men are eager to remain and the best class of new labor is attracted. A stimulating effect is felt by the entire working force, and there is noticed a vim and push and cheer which were not present under the old arrangement. The value of these features cannot be stated in dollars and cents, but it is certain to run into the thousands in the course of a year. To those who are familiar with quarry work under old conditions Fig. 1 will tell the whole story, so far as improved general conditions are concerned.

An interesting development has arisen in the operation of the main units. While the present load on the system is well within the capacity of one compressor, it has been found that the consumption of coal is no greater when the load is divided between the two units than when one compressor furnishes the entire output. In other words, it has been found just as economical to operate the two main units in parallel at about 30 revolutions per minute as to run one at 60 revolutions. The rated speed of the compressors is 90 revolutions per minute, but they are found to have the same efficiency when underloaded as when full loaded at rated speed. A number of conditions combine to bring about this result:

In the steam end of the compressor the losses inherent in the steam engine are greater at slow speed than at high. On the other hand, in a compressor, the load per stroke on the pistons is practically constant. The air pressure is maintained constant by varying the speed of the compressor, this variation being secured thru the pneumatic governor by changing the cut-off; but this variation is so slight that the steam end operates all the time at the cut-off of practically maximum economy.

In the air end of the compressor, light load and low piston speed means that the air during the process of slow compression is in contact with the cylinder walls, and consequently subject to the jacket cooling action during a longer period. The cooling water is more effective in removing the heat of compression, a given volume of water being required to absorb a smaller quantity of heat, a condition which offsets the lower economy of the steam end at slow speed. Again the friction load on a compressor unit is proportional to the speed. A consideration of all of the above items on both sides of the account shows a balance between conditions in the air and steam ends of the unit resulting in efficiency practically uniform at all loads.

A parallel consideration of the steam-driven electric unit shows the disadvan-



R.P.M. 74. Receiver pressure 85 pounds
Inter Cooler pressure 24 pounds

FIG. 3. INDICATOR CARDS FROM AIR CYLINDER.

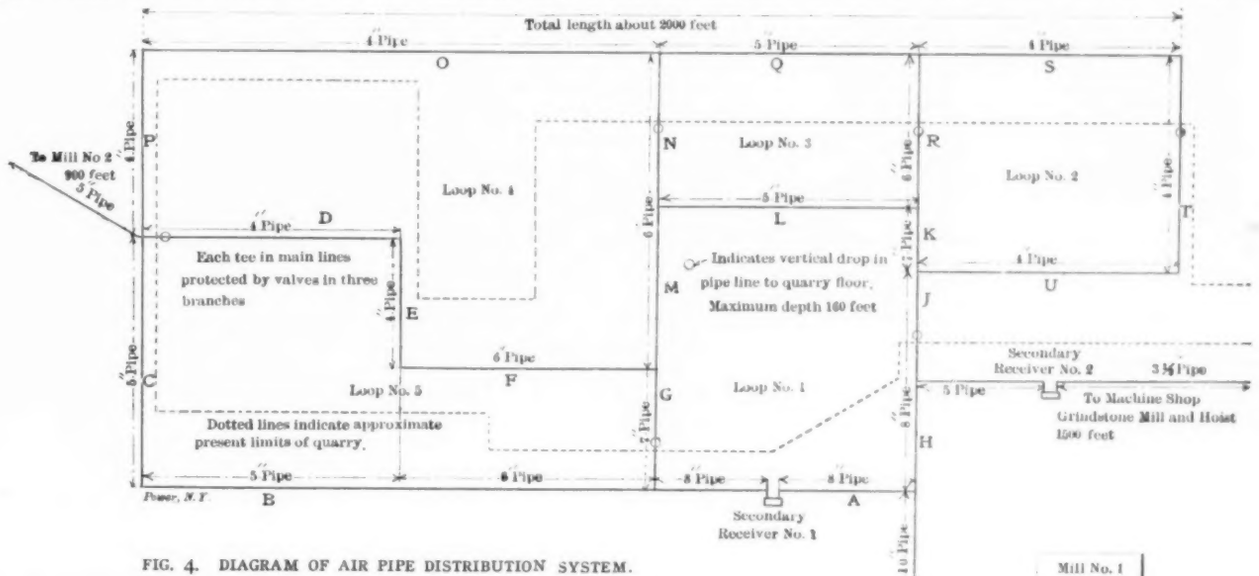

Total length about 2000 feet
4 Pipe
5 Pipe
4 Pipe
To Mill No 2
900 feet
5 Pipe
Loop No. 4
Loop No. 3
Loop No. 2
Each tee in main lines protected by valves in three branches
Indicates vertical drop in pipe line to quarry floor. Maximum depth 160 feet
Loop No. 5
Loop No. 1
Dotted lines indicate approximate present limits of quarry.
Secondary Receiver No. 2
To Machine Shop Grindstone Mill and Hoist 1500 feet
Secondary Receiver No. 1
Power, N. Y.
Mill No. 1
Primary Receiver No. 1
Power House
Primary Receiver No. 2
To neighboring quarries 1000 feet 11¾" casing then Y to 1200 feet 8¾" casing and 1000 feet 8¼" casing.

FIG. 4. DIAGRAM OF AIR PIPE DISTRIBUTION SYSTEM.

tages under which it must operate. A constant speed must be maintained, meaning a constant maximum friction load. The engine operates at the most economical cut-off only at one load. When either underloaded or overloaded its economy is reduced. Not only does the engine operate at lowered efficiency under light load, but the same is true of the generator. The total efficiency of the unit is the product of these reduced efficiencies.

Japs Are Silent Bridge Builders.

Near the camp of the correspondents I watched the pioneer company erect a bridge some 250 feet long and 7 feet above the water at the center. There was no apparent hurry or bustle, no shouting of

FIG. 5. PIPE LINE SHOWING HAMMON GAS JOINT.

orders, no wrangling, no noise. The battalion worked like a silent, well-oiled machine, and it took just four days from the time the men entered the sacred pine forest of deceased Chinese ancestors and began to fell the trees until the last plank was laid, the guard-rails placed, and the bridge ready for traffic. The largest timber used was about 8 inches in diameter. Axes played a very little part, and broad one-man Chinese saws and a linked or sectional folding cross-cut saw took their places. The two-man folding saw is particularly interesting, consisting, as it does, of 6-inch lengths of thin spring steel, ½ inch wide, linked or flexibly riveted, end on end. The saw-teeth are the same size and set as in the ordinary cross-cut saw. By girdling a tree with this saw and grasping a handle in each hand one man can actually cut down a tree, but usually it is used by two men. In one day all the piles, cross timbers and brace ties were cut in this forest.—*Leslie's Weekly.*

General Features of German Education.*

The distinctive qualities of a nation are revealed in nothing more clearly than in its educational institutions. Germany is proud of hers, and the world admits her right to be proud of them. They are regarded with universal respect, and nowhere, perhaps, more than in England. Yet, if one may judge from public utterances, many of those who extol German education have a very vague, if not entirely erroneous, notion of what constitutes its excellence. Otherwise we should hardly have the curious suggestions which are constantly made for improving our own education or the exhortations to copy the American example, for in this, as in other things, the United States and Germany are at opposite poles. To sprinkle "technical" schools, colleges and universities about the country, as from a pepper box, with the aid of millionaires, to modernize the old public schools and universities by substituting science or commerce for classical studies, to secularize elementary schools, and to place within the reach of everybody the same general education up to eighteen or twenty-one—these are, roughly, the suggestions most frequently made. There seems to be a general assumption that the more educational establishments we have, the more "technical" they are and the longer young people are kept in them, the better. Those are the principles which have directed educational "progress" in this country and in the United States, but they are not the principles taught by the example of Germany. In this as in other matters discussed in these articles the distinctive excellence of German procedure lies in the conscious adaptation of means to a definite end. That is why the Germans are so methodical. They do not act at random, because they keep the end in view. They rarely mistake the means for the end or become the slaves of words. The reason is, I suppose, that they think things out more thoroughly than other nations. It has its drawbacks; it makes them slow and deliberate, but it makes them sure, and it is the lesson above all others that we need to learn from them, because our weakness lies in the opposite direction. When we clearly see the end we pursue it as directly as any other people and with unequaled resolution; but we are generally vague and uncertain, we mistake the means for the end, and are perpetually enslaved by phrases. The example of the United States is the worst for us to follow, because there they are also vague, tho not so vague, rather more phrase-ridden, and wildly adventurous into the bargain.

Now, education in Germany is regarded and treated as the means to an end. The end is the production of good citizens and the promotion of national strength and efficiency. I suppose that would be generally allowed to be the end here, but the difference is that in Germany it is kept in view, and here it is not. All kinds of things are substituted. First, education is made an end in itself, then schooling is confounded with education, and its multiplication and prolongation become ends; then some "system" or "method" is exalted into a fetish; the word "science" or "technical" dominates some minds; in others religious animosities or party politics or social ambition or class feeling are the actual motives. Amid all these things the real end drops out of sight. An illustration may be taken from the most justifiable of these aberrations, the cry for technical education. It takes the form of demanding institutions like those of Germany or some other country and multiplying them in a promiscuous fashion. The end is never clearly formulated, but technical schools become an end in themselves. If we really took Germany for an example we should first ask ourselves, Whom are we going to educate, and why? And we should adapt the means accordingly. We have a large number of technical schools, but if you inquire of those interested in them what they are aiming at

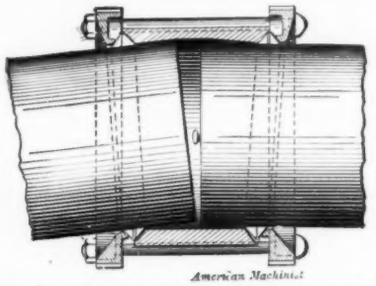


FIG. 6. SECTION OF THE HAMMON JOINT.

you find at once the most vague, confused and contradictory ideas prevailing. Some think their object is to produce better workmen, others that it is to produce anything but workmen. To reconcile the various objects intended to be served by the same institutions, you must have recourse to the most general formula and say that their purpose is to teach something useful to anybody who cares to learn. I dwell on this confusion, not in condemnation of our schools, which have many good points, but in order to make clear by contrast the distinctive qualities of German education. It is not so much the institutions that we should take for our example, as the spirit and purpose which have fashioned them. From top to bottom they have been developed out of the past by a logical process to meet clearly defined needs arising out of the march of events. They have thus become differentiated into many grades, each adapted to a specific purpose.

CONTINUATION SCHOOLS.

At fourteen the children leave the elementary school after eight years' schooling, divided into three grades, and begin to earn their living. Some indeed do that earlier. Broadly, however, the normal course is for boys and girls to go to school

*From correspondence of *The Times* of London.

till fourteen and then to work either at home, helping their parents, or in business. In trades where apprenticeship obtains boys are apprenticed; in others, boys and girls are taken on at a low wage—say, 2s. 6d. [61 cents] a week and work their way up as they grow and acquire the skill. They learn their trade in the place where it is carried on, which is the only place where it is or can be properly learned. But in order to prevent their forgetting all they have learned in school, which they readily do, and to promote their mental development in the same direction, continuation schools have been established, where they get a few hours' instruction in the week from fourteen to sixteen, seventeen or eighteen years of age. There is no uniformity about these schools, which have been developed out of voluntary efforts; they are different in towns and on the land, different for boys and girls, and different again in different States, being compulsory in some and not in others. I confine myself to those bearing upon industrial life. The object in view in the schools is twofold—(1) to continue their general mental development and (2) to help them to become efficient in their trade.

As Düsseldorf is one of the latest towns to establish such schools, it may be taken to illustrate their aims and character according to the most recent ideas. The by-law establishing the schools, authorized on December 10, 1901, provides that all apprentices and youthful workers engaged in every sort of trade, including commercial business, in the town are bound to attend the continuation classes on the days and hours appointed until the end of the school half-year in which they complete their sixteenth year. If they fail to reach the standard required, the liability may be prolonged for another half or full year. Only those are exempted who can produce evidence to the satisfaction of the school committee that they possess the knowledge and acquirements which it is the aim of the school to impart. Youthful workers, apprentices, etc., who have passed the school age may be admitted as voluntary pupils on payment of the school fee, with the consent of the committee. Employers are bound to contribute 1s. 6d. [36 cents] quarterly for each scholar employed by them of school age; voluntary scholars pay the same. Scholars are bound to attend regularly and keep the rules under a penalty of 20s. [$4.87] or three days' imprisonment. The latter has been applied in two or three cases. Parents and guardians are bound not to keep boys from coming, and employers are bound to let them leave off work in good time to attend school, both under the penalty named above.

There are, therefore, both compulsory and voluntary classes, and to these must be added drawing classes for boys, which are also voluntary. The size of the classes varies from 18 to 45. They are held in the elementary schools. The hours are in all cases six a week, namely, from 5 to 8 P. M. twice a week, except for the barbers and bakers, whose hours are from 2 to 5 P. M. No compulsory classes are held on Saturday. The voluntary classes are held on Sunday morning from 9.30 to 12.30, or in the evening from 7 to 9 on one or two days in the week. The subjects of instruction are drawing, arithmetic, reading, composition, bookkeeping, knowledge of social legislation, and other matters bearing on the rights and duties of the lads as members of the community. For instance, they are instructed in the labor laws, the legal relations of employers and employed, workmen's insurance, the object of tariffs, taxation, and similar matters. But the chief energy of the Fortbildungsschule is expended on drawing, which is taught in the most methodical manner and on a carefully devised system. The principle is, while training the hand and eye, to make the exercise bear specifically upon the trade in which the pupil is engaged, and great ingenuity is expended on adapting the lessons accordingly. The lads have to come clean, and particularly with clean hands, which has a good disciplinary effect. Doctor Kuypers, the government district inspector, who has been placed in charge of the Düsseldorf Fortbildungsschule and is responsible for the organization, has studied the English voluntary continu tion schools and formed a high opinion of them, especially those in London. He has utilized various suggestions picked up there in the organization of his own. In Germany, I may say generally, they are very well informed about English institutions and frankly appreciative of their merits.

The German continuation schools are for the most part administered and maintained by the municipality under government supervision and with the aid of a grant. They also receive in many cases substantial support from employers, who have also founded and maintained such schools, where they did not otherwise exist, on their own initiative. Other employers, again, where there are none, insist that their apprentices shall attend neighboring schools. A special class of continuation schools called "work schools" is maintained in the State mining district of the Saar, and the miners of the Ruhr coal fields have a number of their own.

TRADE SCHOOLS.

The education hitherto described is of a general character, with at most an indirect bearing on particular callings. If I am not mistaken there is a general impression in England that Germany possesses a very superior educational system for the training of workmen in their particular trades, to which the industrial progress of the country is largely due; but that is not so. They learn their trade in the workshop, just as our own workmen did in the days when they were more capable mechanics and artisans, if old hands are to be trusted, than they are now. Apprenticeship is still the technical school for workmen to-day in Germany; very few indeed, if foremen are excluded, attend the schools which are called technical in England. There are, however, some trade schools and workshops in which opportunity is given to lads of that class to study their calling more fully and to acquire greater proficiency than is possible in the regular course of ordinary work. Some of them are established by associations of employers, as in the metal industries of the Berg district, which have a school at Remscheid, or by individual firms. Guilds have the power to establish schools for their own trades, which are the handicrafts. They also assist in the classes of the Fortbildungsschule for their own specialty. No comprehensive information is to be obtained about trade schools of this class, but they are particularly numerous and well organized in Berlin. Practical and other instruction in the more artistic crafts is given at art-trade schools, such as that at Düsseldorf. On the whole, it must be said that the technical schooling of ordinary workmen plays a very small part in the industrial development of Germany.

MILITARY SERVICE.

There remains one truly educational factor in the life of the workman, tho it is not usually regarded in that light. At twenty all male German subjects, with some trifling exceptions are liable to service with the colors for two years in the infantry or three years in the cavalry. It is reduced to one year in the case of elementary school teachers and candidates for the post, and to one year's voluntary service for those who have reached a certain standard of higher education or who pass the required examination. Practically, the male population passes thru the ranks at the age of twenty to twenty-two. The liability comes just when a lad has learned his trade, and undoubtedly forms a break in his civil career; but I have met with no two opinions about its educational value to the individual and its industrial value to the nation. Perhaps the most striking effect is the physical benefit derived from the exercises, drills, gymnastics and regular life. It turns a weedy, anemic lad into a well-knit, upstanding young man with sound lungs and well-developed limbs. It further teaches him cleanliness, discipline, order, authority, self-respect and respect for others. The effect in the workshop is visible at every turn. It is hardly too much to say that the military service is, more than any other educational influence, the making of industrial Germany. Employers and employed have gone thru it together; they have learned in the same school, and they understand equally that order is essential to every organized force, industrial as well as military. It is sometimes objected that military training has the defect of making men automata and incapable of initiative. That is certainly possible. Nor can it be

denied that the Germans, and particularly German workmen, are weak in initiative, but that appears to me to be in the national character, which is essentially deliberative rather than adventurous. Their virtue is order, and they do well to cultivate it. Perhaps, if the sole object of the training were social or industrial, it might be somewhat relaxed with advantage, but, as things stand, no unprejudiced observer can fail to see how great a source of physical and industrial strength it is.

Legal Notes.

BY E. P. BUFFET, LL. B.

STEEL HAMMERS—WORKMEN'S TOOL KITS.

In Tompkins vs. Marine Engine & Machine Company it appeared that a young man had been setting a planer tool with a steel hammer and that a chip had flown from the tool, putting out his eye. The New Jersey Court of Errors holds that since the use of a steel hammer for this purpose agreed with a common usage, his employer was not responsible for failing to furnish him with a soft hammer, altho the use of the latter might have been better and also common. The employer is bound to use reasonable care to furnish suitable tools, but not necessarily the best or safest.

In this particular case the hammer had been furnished by the young man himself. The court (per Vroom, J.) says: "Granting that the permitting by the defendant [the employer] of the use of the steel hammer on the part of the plaintiff was an adoption of it by the defendant, it by no means follows that it was an improper implement to use," etc. This raises the interesting and potentially important question, whether, when an employer requires his workmen to supply their own kits of tools, he assumes responsibility for their quality as if he furnished them himself. 58 Atl. Rep., 393.

JUDICIAL ENDORSEMENT OF THE BLACKWALL HITCH.

In the case, Palato vs. International Silver Company, Judge Platt, in the United States Circuit Court, District of Connecticut, has sustained the propriety of using the "Blackwall hitch" for securing a chain to a hook in raising the ram of a hydraulic press for repacking, so far as responsibility for an accident is concerned. The making of the hitch is thus described: "A chain of sufficient length, 6 feet and 9 inches long, having been attached to the ram as heretofore described, was thrown over the hook in such a manner that the chain was supported by the hook above its heel, and crossed in the dip of the hook below and opposite; the free end falling first across the dip, and the weight-carrying portion lying upon the free portion. By this simple device, it is evident that, owing to the force of friction, the chain can carry the full weight of its capacity, and the greater the weight the greater the security." 129 Fed. Rep., 652.

An Old Engine.

EDITORIAL CORRESPONDENCE.

Some years ago, while in Philadelphia, a mechanical engineer mentioned to me that there was a very old engine in a malthouse on Vine street. This engine was supposed to be the oldest engine in the United States. At that time I was occupied with other matters, but a few days ago I recalled the conversation and, after consulting a Philadelphia directory, wrote to the Francis Perot's Sons Malting Company, 314 Vine street, Philadelphia, asking them if it was true that they had an old engine in their possession and requesting permission to photograph it if still in existence. On receiving a favorable reply, promising me every assistance to get the history of the old engine, I went over to Philadelphia on August 10. It would be perhaps as well to mention that this (as far as I can discover) the oldest engine in the United States, is most appropriately the property of the oldest business house in the country, and possibly in the world, if one takes into consideration the fact that it has been carried on in direct line of descent from generation to generation for over two hundred years. Anthony Morris, the founder of the business, came over with William Penn in the good ship "Welcome" in 1682, as a Friends tailor. He was present at the signing of Penn's treaty with the Indians. He first went up the Delaware to Burlington, N. J., 14 miles above Philadelphia, and remained there till 1686. About 1687 he bought a lot on the east side of Front street, below Walnut, erected a brewery and founded the business which has grown into that existing to-day under the firm name before mentioned. There are still in the firm members of the Morris family. Anthony Morris was the second mayor of Philadelphia and was also supreme judge of the Commonwealth of Pennsylvania; he died in 1721. The business descended from father to son, until about the year 1818 Francis Perot, who had served his apprenticeship with the Morris firm (and later married Morris' daughter) started a brewery and malthouse on Vine street. In 1819 Thomas Halloway built for Francis Perot a stationary engine, which of course in those days was a thing to be wondered at. Up to that time most of the manufacturing had been done by water, wind or horsepower, and even treadmills were not uncommon. When the engine was installed the people for miles around came and stood in the courtyard watching it. I can imagine the "lugs" the engineer of that engine put on.

It will be seen by the photograph that there is not enough of the old engine left to tell exactly what it was like. One account states that "the piston connected directly with a crank upon a shaft placed on the floor above," but I was told by a gentleman connected with the malthouse that "the engine worked like a ferryboat engine"—*i. e.*, it had a beam.

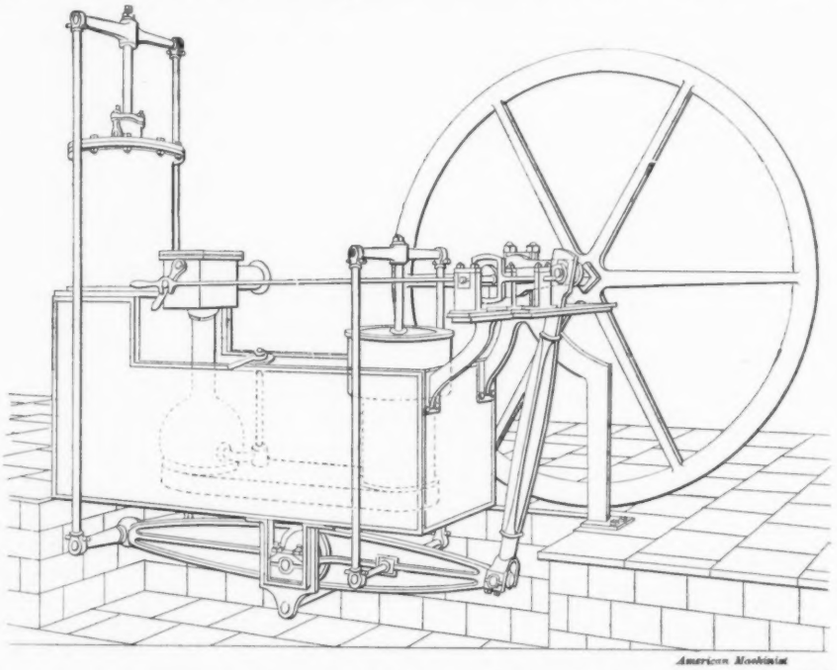


FIG. 2. STEAM ENGINE OF 6 HORSE-POWER BY MESSRS. FENTON, MURRAY & WOOD, 1806.

The engine was in constant operation from 1819 to 1872, when it was taken out to make room for a larger one. The horsepower was variously given to me as from 10 to 20.

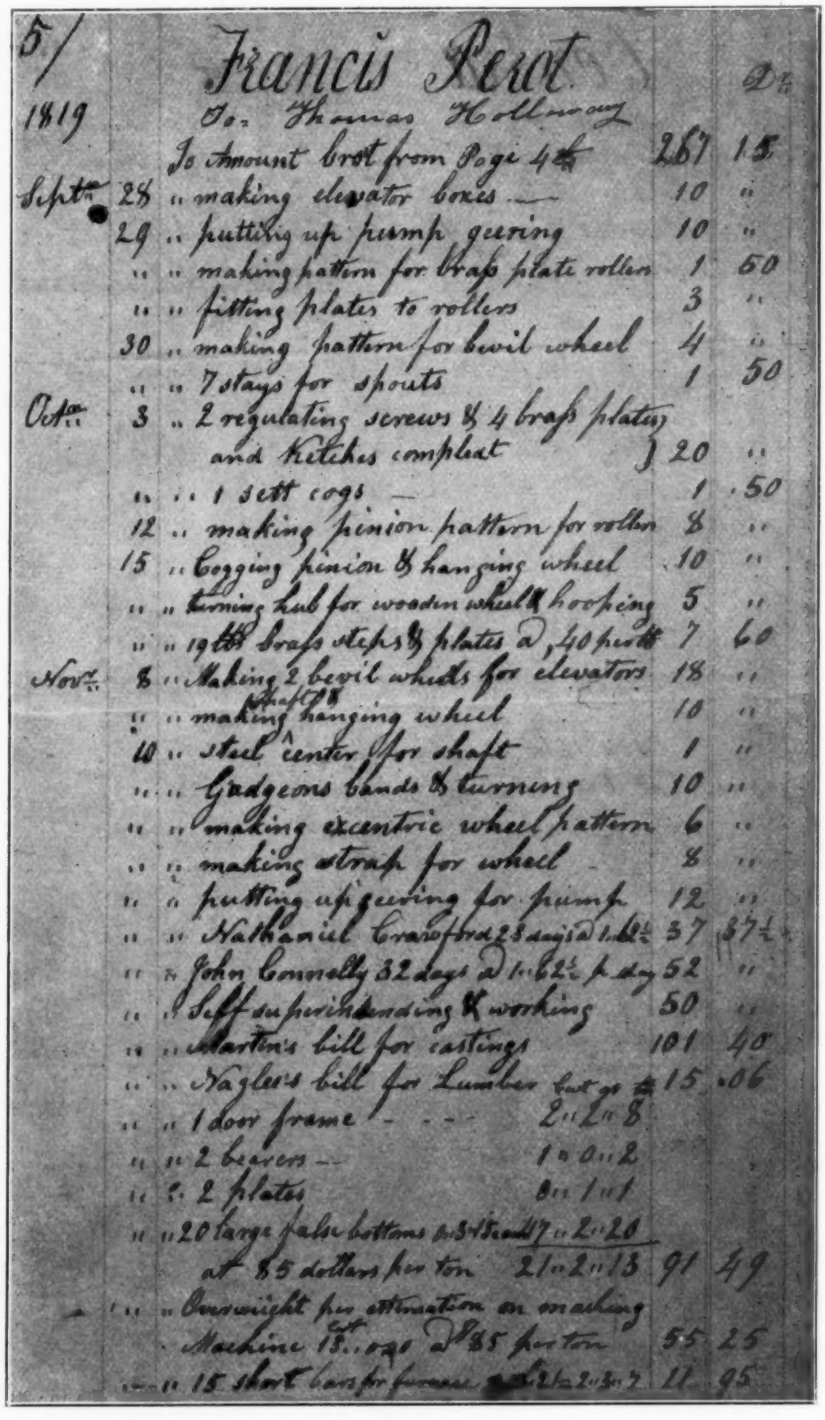
I could get no data as to how much coal was consumed or how many revolutions per minute, or what the steam pressure was. The iron box seen in the illustration Fig. 1 measures 5 feet long, 2 feet deep and 20 inches wide; this was a tank which was kept constantly full of cold water. At Fig. 2 is shown a beam engine with its beam underneath the box; this engine (somewhat similar to the old Perot engine) was built in 1806 by Fenton

FIG. I. AN OLD ENGINE.

Murray & Wood, in England. In Fig. 2 we see in dotted lines inside the tank the bottle-shaped condenser sometimes from its shape called a "pickle pot," and also the air pump. I could not find either pickle pot or air pump, nor could I discover anyone who remembered whether there had been any. As will be seen by referring to Fig. 1, the cylinder, about 40 inches long by about 10 inches bore, was bolted to this box; the round, pipe-like port reaches to the top of the cylinder from a point at one side of the valve chest, where it connects with a short rectangular port opening at its other end upon the valve seat. This port is also bolted on, as is also the valve chest. The engine was double acting; the steam was admitted to the valve chest thru a rectangular opening on the side (next the wall) 3⅝x1¾ inches. I obtained permission from Mr. Perot to take the valve-chest cover off, providing I did not break anything. I had no wrench with me, but I found an old monkey-wrench which had been out in the open air for no one knows how long, the sliding jaw had rusted solid to the bar; however, the gods were evidently propitious, for on trying the wrench I found the jaws just the right distance open to fit the valve-chest cover nuts. I got the cover off without much trouble by working the nuts backward and forward, but the valve was rusted in solid, so that I could not move it. Luckily, the valve was at its extreme forward travel, and this gave me a chance to measure the short port leading direct to the bottom of the cylinder, which was 1 inch wide by nearly 5 inches long. I could not get the size of the exhaust port on the slide-valve seat, but at the bottom end where it should connect with the condenser it was about the same size as the rectangular steam pipe before mentioned. There is no sign of a connecting rod, a beam, the eccentric or its rod.

The shaft *A*, Fig. 1, is 3⅛ inches square, journaled in two places, and is in good condition. The flywheel *B* is about 6 feet in diameter by about 2½ inches face; it has a square hole in the boss. The rock shaft *C* for actuating the valve is in the position it occupied when the engine was in use. The hand lever on the rock shaft has a stud *E* projecting from its inner side, to which the eccentric rod or other actuating device was evidently connected. The governor *D* is bolted to the tank to prevent its being lost. I was unable to find out its original position. The balls are 4¼ inches in diameter, and the distance from center of ball to center of fulcrum is about 28 inches. The pressure gage was a glass tube with a large quantity of mercury in it; this mercury supported a stick with notches in it, these notches indicating the pressure. Occasionally the pressure became so great as to blow the rod and mercury out of the tube. One time when this occurred some of the mercury fell into the vest pocket of the late Mr. Perot; on taking his watch out of his pocket on his arrival home in the evening it was coated with a film of mercury, he remarking to his wife that his gold watch was changed to silver. A few days after this he found that the mercury had eaten thru the gold case.

In following up clues about different men who might be able to give me some information about the engine, I went as far as Wilmington, Del., and Haddonfield, N. J., but all the men I was in search of had long been dead. I did, however, find out that Thomas Hallowel (not Holloway) was a steam-engine maker and lived at 444 North Front street, in 1837, but there was no mention of his business address. I was unable to find out the original cost of the engine, but I got three pages from Thomas Hallowel's ledger giving a list of work done for Francis Perot from May 15 to November 10, 1819. These old pages show that Hallowel charged 3¾ cents a pound for heavy castings in iron such as false bottoms for mash tuns. For two castings for furnace frame he charged 7 cents per pound; brass was 40 cents. A man named Eber Peacock was charged at $2.00 per day, while Robert and James



5/

1819 Francis Perot. Dr.

To Thomas Hallowell

		To amount brot from Page 4th	267	15
Sept.	28	" making elevator boxes —	10	"
	29	" putting up pump gearing	10	"
	"	" making pattern for brass plate rollers	1	50
	"	" fitting plates to rollers	3	"
	30	" making pattern for bevil wheel	4	"
	"	" 7 stays for spouts	1	50
Oct.	3	" 2 regulating screws & 4 brass plates and hitches compleat	20	"
	"	" 1 sett cogs —	1	50
	12	" making pinion pattern for rollers	8	"
	15	" Cogging pinion & hanging wheel	10	"
	"	" turning hub for wooden wheel & hooping	5	"
	"	" 19 lbs brass steps & plates a 40 per lb	7	60
Nov.	8	" Making 2 bevil wheels for elevators shaft	18	"
	"	" making hanging wheel	10	"
	10	" steel center for shaft	1	"
	"	" Gudgeons bands & turning	10	"
	"	" making excentric wheel pattern	6	"
	"	" making strap for wheel	8	"
	"	" putting up gearing for pump	12	"
	"	" Nathaniel Crawford 23 days a 1.62½	37	37½
	"	" John Connelly 32 days a 1.62½ p day	52	"
	"	" Self superintending & working	50	"
	"	" Martin's bill for castings	101	40
	"	" Nagle's bill for Lumber	15	06
		" 1 door frame — 2.12.8		
		" 2 bearers — 1.0.12		
		" 2 plates 8.1.1		
		" 20 large false bottoms 3.15.17		
		at 85 dollars per ton 21.2.13	91	49
	"	" Overweight per estimation on making Machine 15.0.0 at 85 per ton	55	25
	"	" 15 short bars for furnace frame 2.2.3.7	11	95

FIG. 3. A LEAF FROM THOMAS HALLOWELL'S LEDGER.

Peacock were charged at $1.25. Fig. 3 is a reproduction of one of these pages, the inscription "To Thomas Holloway" being of recent date. E. A. S.

Foundry Practise With Copper and Its Alloys.*

Copper and its alloys are very important materials from the standpoint of the electrical engineer, and since a large part of these materials must be shaped by casting, the foundry practise in connection with them becomes important.

The process of casting is apparently simple: Copper is not hard to melt, and when melted it is not difficult to pour the fluid mass into a properly shaped receptacle. Sad experience has, however, shown the foundryman that good results cannot be obtained by any haphazard methods.

The first requirement is that the copper must be heated to exactly the right temperature. If the heating be prolonged and the metal is brought to a bright red heat, it becomes "soaked," as it is called. After being poured there is a period of quietness, and all seems well; suddenly there is a small explosion; the sand is blown from the flask and the metal at the gate flies in all directions. When the casting is examined it is usually found to bear no resemblance to the pattern. If the heating be incomplete and the temperature too low, the action will be somewhat different, but the result will be no more satisfactory. There will be no explosion, but, instead, the sand on the copper rises and breaks up; the metal at the gate swells and the liquid copper continues to ooze out for some time. When examined the casting is found to be full of blowholes, their number depending upon the temperature at which the metal was cast. The effect of overheating or underheating is the same, regardless of the fuel employed—whether coal, coke, oil or gas.

The second requirement is that the sand shall have a proper temper, neither too wet nor too dry; experience alone can teach one how to best fill this requirement. If copper is poured into green sand, the casting will be full of blowholes. On the other hand, dry sand will not hold together. The foundryman's hardest problem is to produce castings free from blowholes. Sometimes a casting will look all right on the outside, but blowholes are found inside when the piece is turned up. Every job requires instructions from the foreman about the temper of the sand, position of the gates and risers.

At the Westinghouse foundry castings are now being made without difficulty which range in size from 1 ounce to 500 pounds. The difficulties have been overcome by observing the following rules:

1. Heat to exactly the right temperature.
2. Have the sand at the proper temper.
3. Melt the copper quickly.
4. Keep the metal covered at all times.
5. Never let the metal stand in the furnace when ready.
6. Add a small amount of silicon copper.

In mixing and melting brass a few simple rules should be observed.

1. Weigh carefully.
2. Melt quickly and uniformly.
3. Prevent volatilization as far as possible.
4. Pour at exactly the right heat.

The first rule may seem needless, but bad results are often traceable to careless weighing.

Pouring at the proper temperature is of the utmost importance. At the present time the temper is estimated by the naked eye, the experience of the melter and skimmer being relied upon to decide when the metal has reached the temperature proper for the alloy and the character of the job to be done.

The use of the pyrometer in the Westinghouse foundry for the determination of temperature has not been attended with great success, chiefly on account of vibration. In other places the instrument has proven unsatisfactory because of its sluggishness in responding to changes of temperature.

A bearing metal resembling glyco-metal has been used in the Westinghouse foundry which gives excellent results. It is composed of copper, tin, lead and zinc. This alloy is difficult to make because of the tendency of the lead, whose specific gravity is high, to settle to the bottom. There seems to be no amalgamation of the lead with the proportions of copper and tin used. To check the precipitation of lead the bottom of the casting was chilled with running water immediately after pouring. This gave good results in small bearings, but did not with large. Finally, methods of mechanical mixing were adopted which gave excellent results both in casting and on test. The test showed remarkably low friction and small wear.

Another alloy was made up of the same elements, but a different scheme of mixing was adopted. The mixing was divided into two steps, the first consisting in making an alloy low in copper, and the second, mixing this intermediate alloy with copper. The intermediate alloy was made by melting the copper first under a charcoal cover and then adding lead, then zinc, then tin; overheating being carefully avoided. This intermediate alloy was poured into ingot molds. After cooling it was put into melted copper. The resulting alloy could be cast in sand and withdrawn while red hot without showing any signs of lead sweating out, altho the temperature of the casting when withdrawn was far above the melting point of lead. The temperature must be watched very carefully, as a slight excess causes the lead to segregate, and, chiefly for this reason, the alloy cannot be made in a Swartz furnace.

In the melting of alloys it is customary to melt first the constituents having the highest melting point and then to add the others in the order of their melting points, the one with the lowest melting point being added last. Sometimes, however, metals will alloy at a temperature below that of the melting point of some of the constituents. For instance, a brass may be made by first melting zinc, which melts at about 800 degrees Fahr., then taking the crucible out of the fire and adding solid copper whose melting point is about 2,000 degrees Fahr.

A singular point about alloys containing lead and tin is that lead will separate out if the percentage of tin is considerably in excess of that of lead, but by decreasing the percentage of tin and increasing that of lead the larger proportion of lead alloys without difficulty.

There is an alloy known to the trade as plastic bronze, which contains 20 per cent. of lead. This large amount of lead is probably held by a small amount of tin and nickel. The alloy gives excellent results.

In the Westinghouse foundry, the molding machines are arranged in two rows, one on each side of the middle aisle. The conveyors, one over each row, carry the sand from spouts which discharge into the flask. The operator, by opening a gate in the spout, allows sand to pour into and fill the flask. When ready for pouring the flasks are set in line along the grating, and as soon as the metal has been poured and is cool enough, the flasks are dumped on this grating, thru which the sand passes to an automatic riddle. The riddle catches and throws out all scrap, nails, etc., and the sifted sand is carried by belt conveyor to a set of rolls. After passing thru the rolls it falls into a self-dumping pan, where a certain amount of water is added, bringing it to the right temper. An elevator takes the sand as it is dumped from the pan and carries it to the overhead conveyor to be used over again.

The sand gave no trouble when the distance handled was 50 feet or less, but after a longer haul it was left in such condition that it would not hold together when the hot metal struck it, but washed away like so much powder, losing entirely the shape of the pattern. When examined under the microscope this sand was found to be entirely disintegrated; the grit and the loam were separated, and formed into globules that would not stick to each other. The difficulty was overcome by passing the sand, after being discharged from the flask and riddled, between a set of chilled rolls. These rolls have to be kept in good shape, for, as soon as they become worn, the sand returns to the disintegrated condition.

*Read before the Electric Club by W. J. Reardon, foreman of brass foundry, Westinghouse Machine Company.

A New Premium Plan.

The pretty daughter of a Cass county (Mo.) farmer offered four kisses to the farmhand who would do the most work in two days, last week, and before night three men had been prostrated by heat.

Electric Driving at the Witton Works of the General Electric Company.

BY EMILE GUARINI.

The works of the General Electric Company at Witton, near Birmingham, are designed to supplement those of the same company at Manchester. They comprise four distinct sections, all of which depend on a single central station for light and power. The first section is for building dynamos, alternators, motors and other heavy electrical machines; the second for manufacturing arc-lamp carbons, cells, brushes and other electrical devices; the third for iron tubes for electrical conductors, cables, etc., the fourth being a foundry.

The current of the central station at Witton is a continuous current while at the Manchester works it is an alternating one. The continuous current was decided upon because the majority of the machines which are to be built there are continuous current machines.

The central station comprises a dynamo of 350 kilowatts driven by a Galloway engine, one of 250 kilowatts driven by a Peach engine, and another of 50 kilowatts driven by a high-speed Bellis engine.

Each generator may be connected either with the testing room or with the workshops. For testing alternating current machines they employ at Witton either a motor generator or the 350-kilowatt dynamo which is arranged to produce either continuous or an alternating current at will. The motive-power current has a tension of 460 volts, that of the lighting circuit 230 volts.

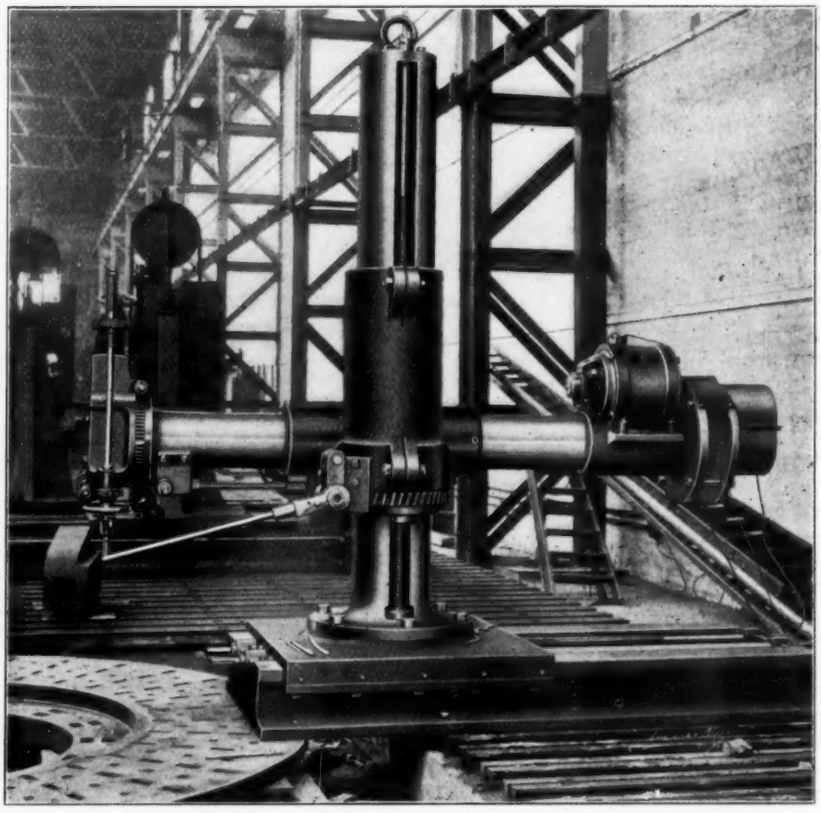


FIG. 2. PORTABLE DRILL WITH ELECTRIC DRIVE AT THE WITTON WORKS.

With the exception of the large machine tools, which, as said, have their own motors, the machines are operated by a main driving shaft. In the workshop this shaft has a length of 300 feet and is divided into three sections, each of which has its motor.

The machine tools are disposed in six groups: edging machines, planing and finishing machines, drilling machines, boring machines, lathes and drills. Each group is placed under the supervision of a foreman. The presence of the workmen is registered by Rochester clocks.

In the workshops for manufacturing carbons the specialty is arc-lamp carbons. The works can furnish also carbons for cells and other electric apparatus, as well as agglomerated manganese.

Three views are given of interesting examples of electric drives of machine tools at the Witton works, Fig. 1 being a heavy milling machine, Fig. 2 a portable drill and Fig. 3 showing two machines, also portable, of the shaper or slotter type which reciprocate the cutting tool either vertically or horizontally or at any desired angle between. The tools are of additional interest to American readers as examples of transatlantic machine-tool design. The ample provision made for locating and securing both the work and the tools upon the floor will be noticed.

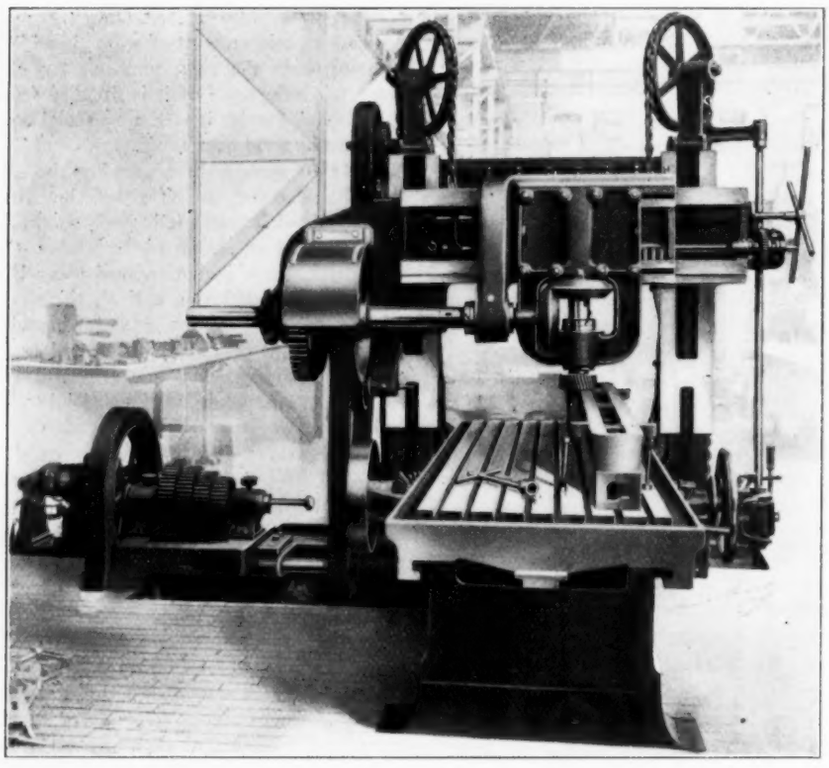


FIG. 1. MILLING MACHINE WITH ELECTRIC DRIVE AT THE WITTON WORKS OF THE GENERAL ELECTRIC COMPANY.

A convenient rule for ascertaining the number of claims that can be written for a patent on an invention by an up-to-date patent attorney is to count the number of words in the first claim and then compute all the different positions these words may be made to occupy by transposition, on the permutation principle.

The Machine Shop and the Home—III.

BY A MACHINIST'S WIFE.

While we were not in society in any sense of the word, yet we knew some nice people and liked to see them once in a while. It did seem a little bit hard to think that it was impossible to accept an invitation and be sure that we could go, and a broken engagement is expensive in many ways. This is how it used to be. We would have an invitation to a little gathering, and I would say, "Will, please come right home from work and I will have supper all ready, and your clean clothes all laid out. That will just give us time to be up there in good season. You won't forget about it, will you?" "Oh, no," he would tell me; he would not forget. And he was good about remembering when I wanted him to do anything for me.

Supper would be ready, a nice little supper that would not make much work after it was over, and I would wait for the man, wonder why he did not come, and try to think how I could explain our absence from the social gathering. Some people are very sensitive about such things and seem to feel that a slight is intended when such a thing happens. By and by the man comes, and he is not in a good humor. He doesn't say much, and I am not very clear as to just why he was not able to come home at the usual time. He hasn't had any supper yet, and a cold supper (and a disappointed wife) does not serve to cheer a man up very much. It is entirely too late to think of going out, and he does not seem to be in the humor to read. Finally he says, "I am sorry that I had to disappoint you, but a fellow had to come in with a small job just before quitting time and I had to stay and finish it."

"Would they not have put someone else at it if you had let them know that you intended going out this evening?" I ventured, as gently as I could.

I wished that I had not asked the question, for I did not like the look that it brought, and the answer came in a tone that I had never heard before. "I did go and explain it as politely as I could, and was given to understand that I was to do as I was told, and when I was told, and if that did not suit me I could get out. If I had a dog I wouldn't talk to him as I was talked to; and if it wasn't for you, little woman, it would be the last time they would ever have a chance to talk that way. They don't own me because I am working there. It is more than likely that that job will lie around half the day tomorrow. I worked as hard as I could to get it done in time so as not to disappoint you, and would have been willing to go without any supper if I had gotten thru in time, and now I will be lucky if the foreman doesn't try to make me work that hard all the time."

It would do no good for me to say anything at this time, and, while I was disappointed, I tried to make as light of it as I could, and the matter was dropped for the time, but it would not stay dropped. We could not buy tickets to a concert or lecture or anything and be sure of having a chance to use them.

The shop closed a day for the circus, and a half day for the county fair. Will said he supposed that that was to give the men a chance for improvement; he said he believed that the owners of the shop thought that was about the level of the men they employed. I did not at all like the bitter way he sometimes had of speaking about the shop. When he first began to work there he was always planning to see how he could make the work go better, but he doesn't seem to take as much interest in it as he used to. I am afraid whenever these things come up that he will want to leave his job and look for another one somewhere else. Leaving that job meant leaving the town, as it was the only shop of any size. I sometimes thought it would be as well if we did move away, as he said that he would never dare to buy a home. He said that the men that owned homes seemed afraid to call their souls their own, and he wasn't going to put himself in that fix.

There was another thing about having to work overtime that he did not think was right. Where he had worked before he came here, when a man had to work overtime he got paid more for it than he did for the regular part of the day, but here he got just the same for an hour of work, no difference whether he worked all night or not. My husband used to say that he did not care very much for the little amount of extra money that it meant, but he did like to have a firm act as if they thought a man had some rights in the matter. By their paying a higher rate for overtime he thought they were acknowledging that they were willing to pay him something for the inconvenience that they put him to by telling him to work beyond the usual hours. He said if a man had any choice in the matter it would be different, but he didn't have. He either had to lose his job or work when he was told to.

I don't suppose the firm could have the work crowding just when they wanted it to be or they would have wanted it that way all of the time, but it did seem very regularly to get hurried in the spring and early summer, while usually there was not full time in the winter. "That keeps me from overdoing the working in the garden in warm weather," Will would say, "and lets me make up all the lost sleep in the winter."

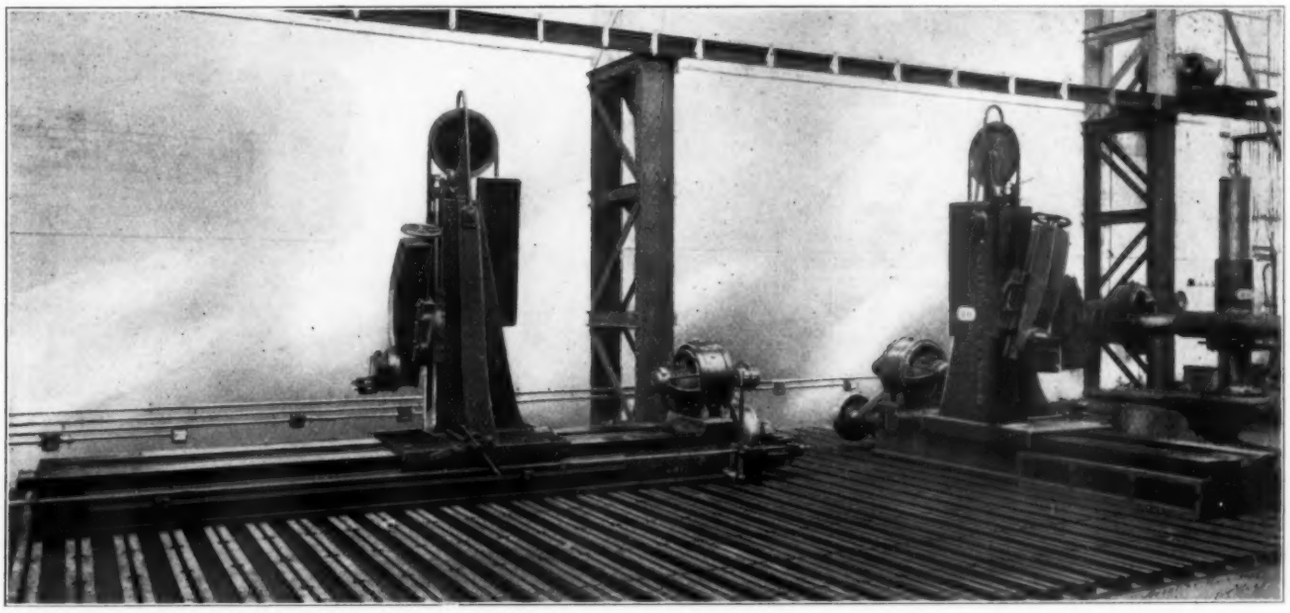


FIG. 3. ELECTRIC DRIVEN PORTABLE TOOLS AT THE WITTON WORKS.

It was very nice to be able to have a little garden, but it was almost impossible to have it do any good unless it was attended to, and it must be attended to when it needs it. I used to do what I could to help it along, but when a woman is doing her own housework, and looking after a family of little children she does not have very much time to work in the garden, and a family should be looked after when they need it, too.

I was very glad that my husband was not a drinking man. I had known men who would go off and get drunk when things did not go right with their work, but he would only go around for awhile with his face sort of set, and he did not want to talk. By and by it would wear off and he would be cheerful again until something else disagreeable would happen.

As a general thing he was well suited with the shop, and with the work that he was doing. These other things were the disagreeable parts of the job. There was one other thing that I was not altogether easy about. There were at times some very rough men at work in the shop. Some of them were not at all choice in their talk or in their actions, and on several occasions there had been fights about it. After one such a time Will had said, "How would you like to move?" I did not want to move, as I had been born and raised in this part of the country, but answered, "I am going to go wherever you go. Why?"

"Oh, nothing much: but if one of those plug uglies ever tries abusing my affairs with his mouth as he did —— to-day the town won't be big enough for both of us at once. I haven't much respect for a firm that will keep such a man around, and if this thing keeps on I may take a notion to look for a job somewhere else 'most any time."

The best that I could do at such times as that was to say that perhaps the men were not as bad as they talked, and that they likely did not mean things as they said them, and try to have the matter forgotten. I am afraid that about the only effect my words had was to have my husband not say anything about such things when they did happen.

I do not suppose that a firm can pay too much attention to the manners of their workmen, for they must have workmen who are skilled in the work that is wanted, still I think it might be profitable if they did consider it to some extent, for I know there are families that object to having their boys go to work in the shops because of the rough, profane way the men are allowed to act in some of them. A store may not be a bit better place than a shop, but there is not a store owner in the country who would keep a clerk whom he had heard talking in the way that can often be heard in shops.

There is one shop where my husband did not care to have me come any oftener than was unavoidable on account of the insulting remarks that were made, not to but at girls and women who had occasion to go in there.

He did not intend that I should know of a personal encounter that he found necessary, nor of another one that he was ready to have, but he said that there were a few men at work there that were ready to make trouble for a certain class even if the foreman would not, and that there were some things that he would not put up with for any job in the country.

I could not blame him very much, but I do think that it should not be necessary for a man to have to fight to secure common decency in the surroundings where he has to do his day's work, and I am glad that my knowledge of shops is extended enough to show me that such a shop is not a fair representative of the shops in this country. I am sorry that there are any like it, for one shop like that can give a bad name to shops in general in the eyes of quite a number of people, and still I believe that most of the men that worked in that shop were good men. Had my husband not worked there I should not have been as apt to know that. A man who has a family to keep can't always work where he would like to.

Slotting Friction-Draft-Gear Cylinders—Milling Air-Pump Cylinders—A Special Milling Machine.

BY JAS. S. SIEGRIST.

The Westinghouse friction draft gear is an apparatus for absorbing and dissipating in friction the energy of impact due to the coupling of railroad cars. With the increasing weight of rolling stock it has been found impossible to provide the necessary capacity in buffer springs; and at best buffer springs are only a palliative of the evil, since their recoil after the cars are coupled is nearly as serious an evil as the direct impact, and increased strength in the springs does not reduce the recoil.

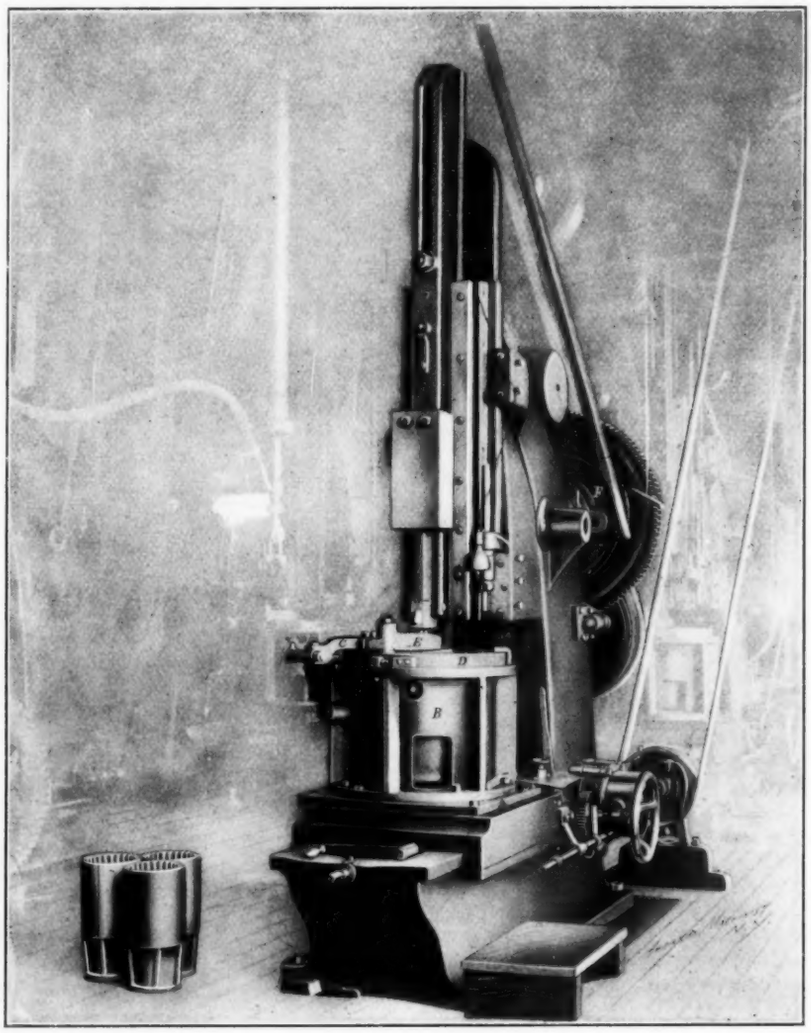


FIG. 1. INDEX SLOTTING MACHINE.

In the Westinghouse friction gear the springs act up to a certain point in the usual manner. Should, however, the impact be such as to compress the springs beyond a certain point, they act upon a conical wedge which pushes a set of friction blocks forcibly outward against the inwardly ribbed walls of a cylinder, and after the blocks come in contact with these walls, any additional energy of impact is absorbed without further compression of the spring, by the friction between

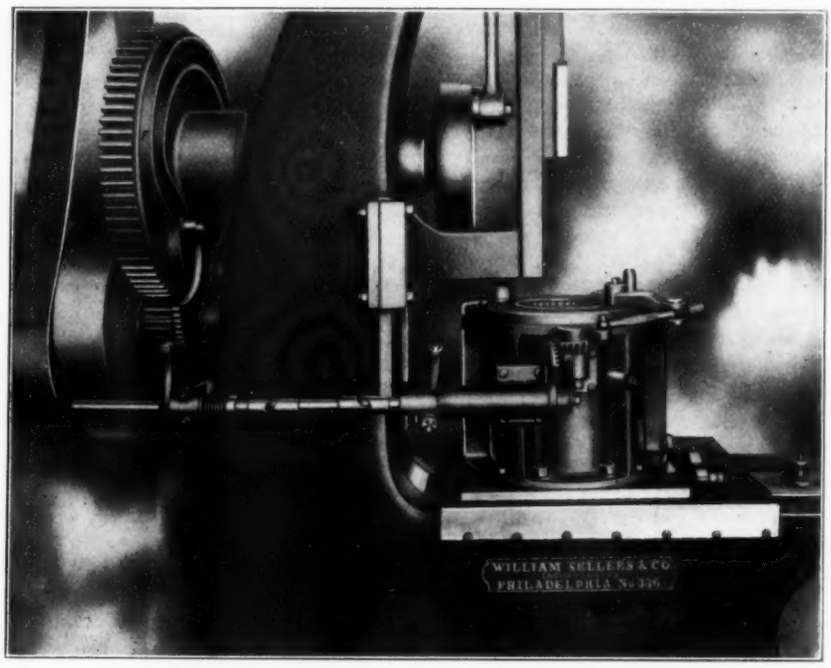


FIG. 2. FEED GEAR OF INDEX SLOTTING MACHINE.

the blocks and the walls of the cylinder. In the recoil the effect is that due to the preliminary compression of the spring only, as all the energy of impact above that due to the compression of the spring has been dissipated in friction. The apparatus acts in starting trains as well as in coupling up and likewise in braking when but a part of the train is equipped with brakes or when the action of the brakes on the different cars is irregular.

Of the accompanying illustrations, Figs. 1 and 2 illustrate a slotting machine as rigged for finishing the ribs of the inner surface of the cylinders, of which three are shown on the floor in the left foreground. The grooves are twenty-four in number, are triangular in shape, 10¾ inches long and taper 3-32 inch in their length. The taper is obtained from the base-plate *A*, Fig. 1, which is tapered in thickness and secured to housing *B* for holding the chuck. The cylinders are fastened in the chuck by means of set-screws, which can be reached with a socket wrench thru holes in the housing, as shown. The chuck is free to turn in the housing, and is automatically moved one space for each stroke of the tool. This movement is obtained by means of a cam *F*, Fig. 2, on the main driving gear. A roller fitting into the groove of the cam is fastened to a rocker arm having gear teeth which mesh with another geared sector keyed to a shaft, all as shown in Fig. 2. The shaft has two universal joints and extends along the side of the machine to the chuck, where, by means of a miter gear and connecting link, the motion is transmitted to the rocker arm *C* and feed ring *D*, Fig. 1. Part of the travel is taken up by the rocker arm until it abuts against a stop, when the feed ring moves during the remaining part of the stroke. Fastened to the feed ring is another rocker arm *E*, the long end of which engages in one of the grooves of the draft gear cylinder, while the short end is actuated by the rocker arm *C*.

The operation is as follows: When the machine nearly reaches the end of its upward stroke, arm *C* moves forward and engages the end of arm *E*, disengaging it from the groove in cylinder, when it and the feed ring move forward one notch, until the end of *E* is opposite the next groove. At this point, as the tool starts downward, the arm *C* travels in the other direction, causing the end of arm *E* to drop into the groove when this arm and the feed travel back and move the cylinder one notch. This entire movement takes place after the tool has left the work on its upward stroke and before it starts to cut on its downward stroke.

On the right side of the machine, as shown in Fig. 1, is a feed arrangement for the table.

When the cylinder is finished, it is necessary to move the table out far enough so that the cylinder is clear of the tool before it can be taken out of the chuck, which is done by means of the arrangement shown on the right of the machine in Fig. 1. This arrangement is provided with a clutch, which may be engaged with either of the two pulleys and moves the table either in or out, as may be desired, and throws out automatically when the table reaches the end of its travel.

As this operation is made only after the machine is stopped, the driving pulley is fastened to the loose pulley on the countershaft, so that the mechanism is in motion only when the machine is not running, thus preventing the clutch from being thrown in accidentally and moving the table when not desired.

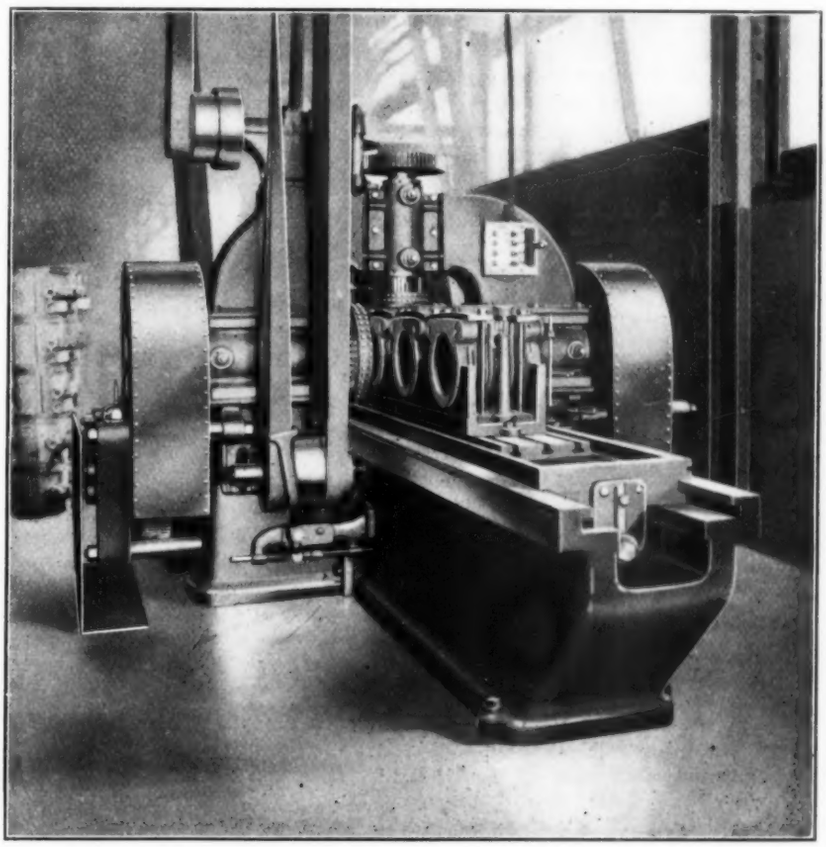


FIG. 3. THREE-SPINDLE MILLING MACHINE.

One of the cone pulleys on the countershaft is provided with a brake having a rope attached extending close to the handle of the shifter, so that the machine may be stopped when the tool is at the end of its upward stroke and clear of the work.

As will be seen in the photograph, a traveling air hoist is used to facilitate the handling of the cylinders.

Fig. 3 shows a horizontal milling machine used for facing the two ends and the flange of gray-iron cylinders for air pumps. There are three milling heads, two horizontal and one vertical, the three surfaces of the cylinders being finished in one operaftion. Each of the horizontal heads is 14 inches in diameter and has forty cutters; the cutters fit in slots and are secured by means of a steel ring having two set-screws for each cutter. Every tenth cutter has a slot running lengthwise into which the ends of the set-screws fit so as to prevent the ring from turning. The vertical head, which is smaller, has thirty cutters secured in the same manner. The cutters are run at a speed of 30 feet per minute; they have three speeds and have a 3-inch endwise adjustment. The table work surface is 12 inches wide, 10 feet long, and has a screw feed and power quick movement in either direction at the rate of 15 feet per minute.

The feed of the platen is positive by change of gears from 1 to 12 inches per minute at any spindle speed.

The machine is provided with a frame for holding five cylinders, each being fastened independently so that as soon as the first cylinder is fastened the machine may be started and while it is being finished the others may be put on; similarly after the first cylinder has passed thru the cutters it may be removed, and so on for the five cylinders, thus saving considerable time in the chucking. About one hour's time is required for finishing five cylinders, including the chucking and removing.

A large addition has recently been made to the Singer sewing-machine factory at Kilbowie, near Glasgow, the new erection being 800 feet long, 80 feet wide and six stories high, adding 8½ acres of floor space and bringing up the total to 32 acres. The erection is no cheap affair, but represents advanced modern construction. In its construction over 60,000 tons of material were used and 17,000 tons were excavated to insure a sound foundation. The materials included 8,000,000 bricks, 7,000 tons of concrete for the foundations, 4,000 tons of steel and iron structural work, 1,500 tons of timber and 14,000 of "ferrolithic." The latter is a concrete of great strength and fire-resisting properties, consisting of cement and steel furnace slag and used in casing in the columns, girders and joists and in forming fire-resisting partitions which divide the building thru all its stories into four self-contained divisions. The erection was accomplished in six months.

Mechanically-Made Cores—A Practical Core Machine.*

Many attempts have been made to produce duplicate cores by mechanical methods. These methods may be divided into three classes. First: those which depend upon sifting or shoveling the sand on to a rotating arbor and then striking it off to the proper form. Second: those which depend upon ramming the sand into the mold or form, either entirely by machinery or partially by machinery and partially by hand. Third: the use of machines which form the cores by causing the sand to flow thru a properly formed orifice under a steady and uniform pressure.

The first method is used very largely in the making of pipe cores and other loam cores, and for this purpose it has been found very successful, as it is not a matter of ramming in the loam core, but merely getting the soft loam in place and properly formed for baking, the loam being so soft that it will flow readily; hence it cannot be rammed hard like ordinary tempered sand. This same method has been used to some extent in the making of green-sand cores, in which the sand is sifted or shoveled on to the arbor and swept off by a strickle board or sweep. Cores made in this way, either from green sand or loam, always require some facing or blacking, and green-sand cores are liable to be very different in density at different points, resulting in irregular venting, and frequently with the accompanying results of scabs and bad castings. At present there is no machine operating upon this principle in general use in this country for making small cores.

Under the second class we find a number of devices on the market. For making short cylindrical cores a stripping core box is in quite common use, especially in Europe. This arrangement consists of a plate having one or more holes of the required diameter and fitted with a plunger or plungers for stripping or forcing the cores out of the holes. The cores are rammed by hand and are subsequently stripped out by forcing the plungers up, usually with the foot lever. Such a device as this has two disadvantages. First, if a permanent or fixed vent wire is used, the ramming must be done around it; hence the wire is very liable to be bent or crowded out of shape and in drawing it thru the core it is liable to disturb the interior. Second: it is only possible to make short cores in this way, as the surface friction would prevent the stripping or forcing of a long core from the box, and it would also be impossible to ram a long core evenly. The forcing of these cores out by means of a lifting plunger would naturally tend to make the lower part more dense than the upper.

Other machines have been devised in which a reciprocating plunger is used to force the sand thru the form for producing a long or continuous core. It will readily be seen that every time the plunger retreats it must leave an impression of its face upon the sand, and as more sand is crowded in front of it a parting would naturally be formed in the core. As a consequence, a machine of this type cannot produce a continuous solid core.

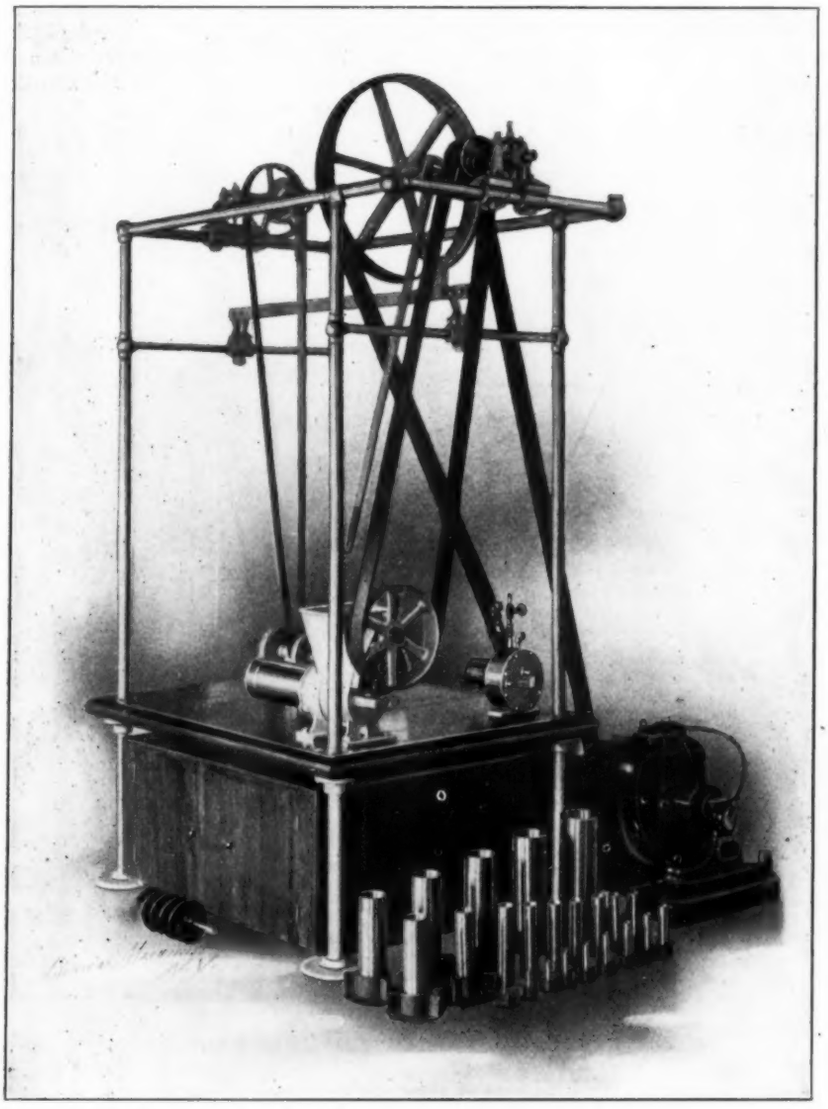
The third class of machine must necessarily be fed by some device which will crowd a continuous and unbroken stream of sand thru the die, and the only successful device I know of for accomplishing this is a screw and the machine is of the well-known sausage-mill type. It looks like a very simple matter to apply a screw to force material thru a die to give it the desired form, but it must be remembered that sand is an aggregation of extremely sharp pieces of mineral matter, and when mixed with a bond, as in the core mixture, it is neither fluid nor even semi-fluid, and as a consequence no small amount of skill has been required in dealing with such a mixture. The successful development of a core machine of this type has only resulted after the solution of many little but important problems. It is now possible to produce not only cylindrical cores but cores of any prismatic section, and of considerable length, by this means.

The question of a vent thru the core is quite important. The first suggestion would naturally be to introduce a short point on the screw and let it leave its own vent, but this point is constantly rotating and is subject to a very peculiar scour by the sand as it leaves the screw and takes its course into the die. As a result, such a point is soon worn out of true and finally destroyed. It has been found that better results can be attained by having a hole thru the center of the screw and using a stationary vent pin passing thru the screw and its shaft and held in position from the outside of the machine. As the core is rotating, the wear upon such a pin is uniform at all points; hence it always remains in the center and always produces a true vent, but one of the very unexpected results with this style of vent has been that the pin is worn very slightly indeed. In this connection, while considering the matter of wear, it may be interesting to state that while it was natural to suppose that the core-machine dies would be cut out very rapidly indeed by the sharp sand, to our surprise it has been discovered that the wear of the dies is very slight and that they maintain their size and shape almost indefinitely.

The matter of the feeding of the material into a machine of this type is of importance, as it has been found that the screw must be supplied with material no faster than is necessary to supply the amount of sand for the core being made. If the screw is buried under a large amount of sand, it simply cuts out a cylindrical form, the top becomes bridged over and the screw ceases to feed sand forward.

*Paper read by George H. Wadsworth before the Philadelphia Foundrymen's Association, September 7, 1904.

This type of machine was first used for cylindrical cores, and it was found that the core as it came from the machine had a slight rotary motion. This rotary motion resulted in a very smooth surface upon the core, and, as oil is used for a binder, the result is a very smooth surface which requires no blacking or slicking. When it was finally decided to make prismatic cores, it was first supposed that the surface would not be as good as in the cylindrical cores, but it has been found that by very careful arrangement of the sides the die surface gives practically as smooth a surface in the prismatic cores as in the cylindrical ones.



CORE-MAKING MACHINE.

For grinding any material—that is, for cutting its surface with an abrasive, it is necessary that the abrasive be set in some bond which will hold its cutting edges firmly in position while they are doing the cutting. In the case of core sand in a relatively large body being forced thru a machine, the individual grains are to a large extent free to move among themselves, and, as a consequence, the moment a sharp corner comes in contact with the metal face the grain has a tendency to rotate about this point and place itself with a flat face in contact with the metal surface. A soft die, or a relatively soft die, is undoubtedly better for this purpose than a hard one, on account of the fact that it gives the grains a better chance and grip for turning. This movement of the individual grains results in a very smooth surface which when baked is hard, smooth and porous, and also results in very little wear on the die. A similar action undoubtedly takes place about the stationary vent pin and greatly reduces the wear upon it.

The best cores that it is possible to make in a machine of this kind can be produced from a mixture of silica sand, flour and oil. The silica sand should be clean, sharp and free from loam or clay, but as practically all founders use sand from a local bank or lake sand, experiments were made with this class of material, and it has been found that very good cores can be produced from any good, sharp sand which is free from loam or clay, when mixed with the proper proportions of flour and oil. The oil used in most cases has been boiled linseed, but it is probably true that with some sands other core oils may be found valuable. The material is worked drier in the machine here exhibited than in hand ramming; in fact, it would be totally impossible to make good cores by hand from the material when properly tempered for use with the machine.

In this connection it may be of interest to say that some very interesting experiments were tried recently with the use of loam and bank sand without any oil or flour whatever. A mixture of one-half ordinary swamp loam and one-half bank sand is used. This produces a very porous core, having an exceedingly good surface, and a core which drops out of the casting or can be cleaned out very easily, as the loam burns out and leaves the core very free. The one point necessary in using such a mixture as this is to be sure and have ample provision for carrying away the vent, as considerable more gas is generated than with ordinary core mixtures.

The question has been asked frequently, "What lengths of cores can be made in this machine?" Thus far the efforts for the production of cores have been confined to a length of 24 inches, but recently an experiment was made to see how long a core could be run out, and a core 10 feet 6 inches long and 6 inches in diameter was made without any difficulty. If any firm desired to go to the expense of sufficiently stiff supports for receiving the core there is evidently no reason why cores of considerable length cannot be made without any difficulty.

As most foundries are using hand-made cores, it may be of interest to compare these machine-made cores with hand-made cores. In the first place, practically all hand-made cores are rammed with some form of rod, which must of necessity result in very unequal hardness in different parts of the core and consequent unequal venting. The core mixtures necessary for hand ramming have to be worked wetter than those for the machine, requiring longer time and considerably more fuel to bake. When the core is rammed in a core box, the sand remains at the point in the box with which it first comes in contact and is simply compressed in that position. The result is that the grains of sand on the surface of the core may lie in any position and hence cannot give as smooth a surface as is the case when the sand is forced thru a die, which slicks the surface. It is true that some hand-made cores are used without blacking, but in most cases blacking is necessary. I believe that with the proper selection of core mixtures blacking can be dispensed with on practically all small machine-made cores, such as can be made with a machine of the type mentioned, and which I have the pleasure of demonstrating before you this evening.

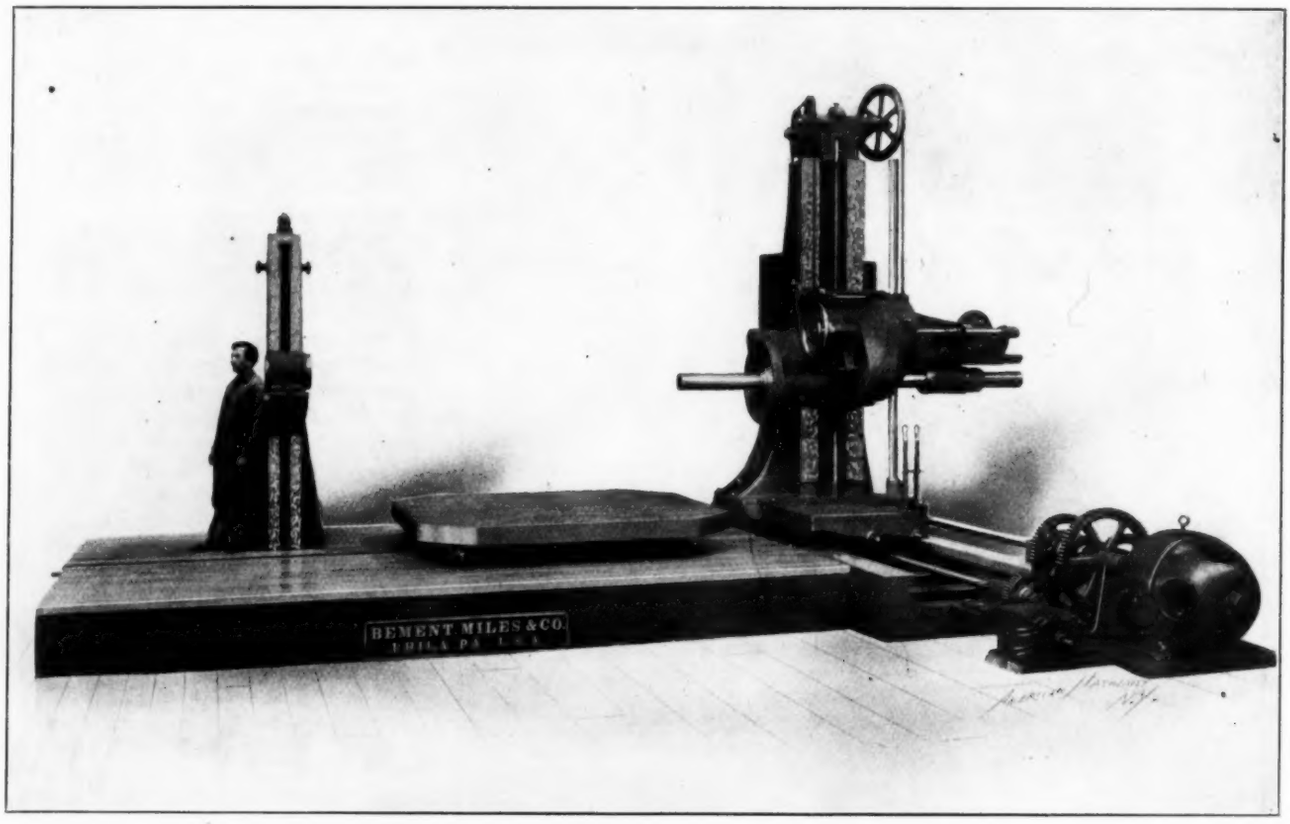
[The machine as shown in the half-tone

is driven by the electric motor behind it, belting up to a countershaft and then down to the machine. On the table at the rear right-hand corner is a motor which may be driven by either steam or compressed air and belted direct to the machine. The machine may also of course be driven by belt from any running shaft. In the foreground are shown the screw of the machine and dies or formers for cores of different sizes. The emery grinder in the rear is used for coning the cope ends of round cores. The machine is the invention of the author of the paper, and is built by the Falls Rivet & Machine Company, Cuyahoga Falls, Ohio.—Ed. A. M.]

In the *Iron Molders' Journal* for September is a "symposium," to which some fifteen writers contributed, upon the apprentice ratio in foundries. The discussion had to do with stove foundries exclusively and considered the proposition of the Stove Founders' National Defense Association to change the shop ratio of molders to apprentices from 8 to 1 to 5 to 1. The writers were practically unanimous in recommending the change, altho for different reasons, the most prominent appearing to be that the ratio proposed would practically make no change from actually existing practise. The change is also editorially advocated. The writing throughout shows the best of feeling as existing between the employers' association and the organization of the molders.

A Large Horizontal Boring, Drilling and Milling Machine.

The illustration shows a large horizontal boring, drilling and milling machine with rotary table, recently built by the Bement-Miles works of the Niles-Bement-Pond Company for the American Bridge Company. The spindle is 5½ inches in diameter and has a 72-inch traverse in two passes. The saddle has a vertical adjustment of 6 feet 6 inches on the column and the column has a traverse of 10 feet on the bed. The spindle is driven by a motor operating under the multiple-voltage system and which develops 11½ horse-power at its lowest speed. The motor has a range of speeds from 370 to 1,030 turns per minute, and three changes of speed are provided by gearing, giving the spindle a speed range of from 2 to 61 rotations per minute. For the rapid traverse of the column and the saddle, an independent 6 horse-power motor is provided. The floor plate, which is 12x18 feet, is provided with a revolving table 8 feet square, or 9 feet 8 inches across the corners. The spindle has six speeds—three suitable for drilling and three for boring. The machine is so arranged that milling feeds and power-rotating mechanism for the table may be attached if they are required. The rapid traverse of the saddle and the column are controlled by levers from an operator's platform which is attached to the column. An outboard column is provided, which has an adjustable bearing and which may be moved to any part of the floor plate.



A LARGE HORIZONTAL BORING, DRILLING AND MILLING MACHINE.

Echoes From the Oil Country—The Young Machinist as a Salesman.

There are many things that machinists have turned their hands to and in which they have found that their training in the shop has been of great advantage to them. It is often remarked that many men who are on the road as salesmen for machinery and for machinists' supplies do not have a working knowledge of either line. At once it is concluded by many that here is a place that the shop man who wishes to better his station in life should seek to get into and to fill. His knowledge of the shops, of shop conditions, and of shop men is looked upon as giving him a decided advantage over the man who does not have such knowledge. If they stood on an equal footing in all other matters, it undoubtedly would be so, but it must not be forgotten that the man who travels around and sells such things has quite a variety of problems presented to him for solution, and some of them may call for experience that is not acquired by working in a machine shop.

David was a good machinist. He knew all about the tools and the supplies that machinists use. He had gone out and figured out what was needed to fit up a small factory and get it running, and had been able to make the sale to the satisfaction of all concerned. He had always been received with courtesy, and his advice had been appreciated.

Here, now, was an opportunity to "go on the road." Going on the road meant

wearing good clothes, and traveling around and stopping at the best hotels, and getting on terms of friendship with the proprietors of machine shops (and they are all nice men, whom it is a pleasure to meet), and a whole lot of other nice things, besides the one of drawing a big salary and having a chance to become a member of the firm. David left the job he had and accepted this situation.

Things do not look as rosy to him just now as they did before he left the shop—that is, the nice things in the salesman's life. Perhaps in time he will learn to feel at ease whether he is able to sell goods or not, but he has not reached that stage yet. He had been used to getting definite, visible results from the efforts he put forth in the shops, but now it was far from being that way, and after a particularly unproductive period he would view with apprehension the letters he received from the firm and would open them with fear. It was one of the surprises that he found in his new calling that they kept him. A page from his regular experience may show how gay he found life on the road.

R-r-r-r-r-r-r-r! There Davy, my boy, that is the call loud enough, and it means that if you are going to get that 5.14 train you will have to get right out. Of course you can't get any breakfast here at this time in the morning, but the next train doesn't leave until 10.42, and if you wait for it the day will be almost done. At 8.37 David is at his town, finds he has six places to call and also finds that there are just two trains a day away from it. One goes in the night, and the other one between 12 and 1 o'clock. No time to wait for breakfast if he is to see these people. He has found out that he is more apt to find the men he has to see around the works in the forenoon than in the afternoon and inquires his way to the nearest shop, and enters the office and presents his card. You will understand that he is a stranger who is trying to get a foothold where experts at the business have already worked the field and have arranged to the best of their ability to keep in, and incidentally to keep others out.

"Ah, studs, set and cap screws, drills, taps, emery wheels, etc. We are not in the market for anything in that line today," and before David knows just how it happened he is on the outside.

At the next place he does not get any farther than an entry. A boy takes his card to the mysterious realms beyond and after what seems to him a long time, he receives it back with the information that Mr. B—— has not come down yet but may be expected at 11 o'clock.

Here is one bright spot at least. He has known of the firm of Chips, Polish & Co. ever since he has known life in the machine shop and it will be a real pleasure for him to at last have a chance of meeting these men. With joy he hands forth his card and asks for Mr. Chips.

"Chips?" in a very inquiring way; "I am afraid you have mistaken the place. What Mr. Chips was it that you wished to see?"

"Why, Mr. W. I. Chips, the head of the firm, of course."

"I am very sorry. There are others of us who would like to see him too, but we can't. He has been dead for several years."

"Perhaps it would be possible for me to see Mr. Polish, then."

"No. After Mr. Chips died Mr. Polish did not feel like continuing actively in the business. A stock company was formed and now he is only connected with the company as a stockholder."

"Can I see the purchasing agent?" asked David after pausing a moment to show his sorrow at the passing of his old shop friends. He had never really known them, but somehow the information he had just received seemed to sever another strand of the ties that bound him to his old life in the shop without replacing it by one that reached to his present life.

"The purchasing for this plant is all done thru the Pittsburg offices," was the reply, and David feels that it is useless for him to spend any more time at this place.

The next place he struck was a little more unpretentious. As he stepped into the office the sights and the smells that greeted him were so nearly like those he had known that he would not have been much surprised to see the old bookkeeper at the desk, nor to have had the proprietor he had worked for come walking in from the shop.

As soon as he stated his business he was told to go out into the shop. He would find the owner there somewhere. He felt very much at home as he got among the familiar sights and sounds, and did not have any trouble in locating the proprietor. His hands were as dirty as those of most of his men, and his face was not entirely clean, but he did not have overalls on, and he wore a starched shirt and collar. It was no trouble to talk to him, neither was it any trouble to sell him the things that he needed, but the shop was small and so was the order, but small as it was it was an encouragement that was needed just then. The shop talk and the hearty grip of the greasy, dirty hand were both received with a pleasure that was never counted among the pleasures of being on the road in the days before that life was started. It was even a pleasure to see the piece of waste produced and the hand carefully wiped before it was extended. While the uninitiated who sees this done may often wonder, on seeing the waste, whether it is the intention to put dirt on or get it off, every shop man knows that to get anything really clean there is nothing equal to the piece of waste that is carried in the pocket.

The next place on his list he finds is closed and in the hands of a receiver, and the stories that he hears about another one being very near to the point where the good offices of the sheriff are required makes him believe that it is not best to go there. If the reports are true he could very likely get a large order, but he has been given to understand that it is part of his business to know something about the standing of the firms in their home towns and to report on that when he sends in the orders. Many a man is doing a safe, honorable business who is not rated by any mercantile agency, while some people would like to know of a way to get their money out of some who have a very good rating.

There is one call still to make and dinner to get before that train, and the time is none too long. David afterward wished that he had gotten his dinner and neglected to make the call. As it was, he made the call and got a grab dinner at the depot restaurant lunch counter and had to finish it on the train.

After having to wait for some time at the place of his last call, David was admitted and began to state his case, but did not get far before he was interrupted with: "What is the tensile strength of the material your firm puts into their cap screws?"

David had never heard it mentioned, and did not dare to even guess at it.

"What is the carbon of the steel you use for set screws?"

Again David had to admit his ignorance.

"You say your milled coupling bolts are the finest in the country. What limit do you allow on diameter, and how near round must they be to pass your inspector?"

David could only protest that they were round and true to size. *How* round and *how* true were things he did not know.

His questioner handed him a set screw ¾x2 inches. "Do you make a better set screw than that one?"

It was a nice-looking set screw. The threads were sharp and smooth. The head was square, and the point appeared all right.

"That appears to be a very good set screw," said David, and as he thought of some of the set screws that he had used in the shop he added, "I think it is better than the average."

"Perhaps it is, but it is not good enough for our work. I am sending the entire last shipment back. The pitch on that one measures nearly 5 per cent. out of the way, and on some sizes I have found a variation of as much as 7 per cent. I got a lot of goods from your firm once and they were poor. I am beginning to think that the only way I can depend on getting good goods is to make them myself. As we are very busy I do not like to do that, but it seems that you salesmen do not know enough about what your firms do really make to be depended on to state the facts in the case." David had

to listen to quite a lot more before he was dismissed, and felt that he was fortunate in having been allowed to get safely away. He felt that he had been made to suffer for the sins of all of his kind. That and his hunger made him forget all about the man who might possibly have been seen at 11 o'clock.

A slow journey on a slow train, a layover at a junction where there was not the ghost of a chance to do business while a wreck was being cleared away somewhere down the track, and a hotel was reached in time for a late and poor supper. As David crawled wearily into bed that night he thought of the days when he began work by the whistle in the morning and quit by it at night, and was able to see the result of his day's work piled up before him when he went. He feels worse than he did when he entered the shop, a callow youth whom the men used to delight to send after the white lampblack or some other equally foolish errand, and in learning now he has not the same chances of doing so by observing the work and methods of others that he had then.

It was thought of one young man who had been sent on the road and had not been very successful in sending in orders, that perhaps his methods of approaching people had been poor, and on his return from one of his trips the head of the firm had requested him to go out and come into the office as tho he were coming into a strange office to sell goods.

The young man went out and sent in his card and was admitted. He found the proprietor busily engaged writing, and waited respectfully, hat in hand, until he was noticed and spoken to. He then told as briefly as possible the merits of what he had to sell, dwelling on the things that he thought might be of most interest to his listener. He tried to answer questions addressed to him with clearness, but without unnecessary elaboration. The decision was that, while some of his ways were capable of improvement, it was felt, and said, that he did very well for a young man with a limited experience.

The necessity of studying the man he had to deal with, and of always acting with the utmost courtesy was impressed on him, and then he was asked if there was anything he would like to say. He said he would like to have the proprietor go out and come in and give him an illustration of how to act, while he would represent the man in the office.

It was agreed, and when the proprietor came in he found the young man with his feet on the desk, a cigar in his mouth, and he was leisurely perusing the sporting news of the daily paper. It seemed to be very interesting, for it was some time before he looked up. When he did he did not ask his visitor to take a chair, but remarked without going to the trouble of putting his feet down or of removing the cigar from his mouth, "What d'you want?"

As the proprietor started to explain the line of goods he represented, he was cut short with: "Oh, come off. Give us something fresh. You fellows go on like a lot of parrots. You make me tired. The office force fills you up with a lot of stuff. They know blamed little of what they are talking about, and you fellows know a mighty sight less. Why don't they send men out to sell that know something?"

The proprietor kept cool and said that he would be glad to explain anything about the goods he sold that the other wished to know.

"That would be all right if I could believe what you said, but I never yet met a traveling man who wouldn't say anything he thought would go about his goods."

"We will be willing to send our goods subject to approval. If they are not exactly as represented, you may return them."

"Don't you worry, sonny. If you or anyone else tries to work off any of their snide stuff on us they get it back, but we can't be making expensive tests for you for nothing. *We* buy of reliable concerns who do not have to send their goods on trial."

"All we ask is an opportunity to show you whether our goods are good or not. I think we could make it to your advantage as well as to ours if we only had the chance."

"Oh, yes, of course. That is the way they all talk. The fellow that sent me the worst lot of goods I ever received talked the nicest. You are a very nice young fellow and you have your lesson pretty well learned, but I am too busy to waste any more time with you." And the very urgent and important business of seeing the standing of the league ball teams is resumed.

I am not very clear as to the line of advice the young salesman received when he and the proprietor resumed their places. Possibly the proprietor was not entirely new to the trials of a young and inexperienced salesman. W. OSBORNE.

Among the numerous protective devices employed in the New York subway equipment an interesting and important one is that of the flexible metallic conduit made by the Sprague Electric Company. This is a tube formed by a succession of steel convolutions combining great flexibility with perfect protection to the insulated wires within. Injury from rodents or from mechanical abrasions is effectually prevented and even a short circuit will produce no serious damage, so that safety to the passengers is greatly promoted. This is by no means a new or isolated employment of the flexible conduit, as it is extensively used in the best modern buildings, flexibility not being its only feature of value.

Letters From Practical Men.

Surface Grinding and the Magnectic Chuck.

Editor American Machinist:

We used to use the plate and fingers to pinch the work down, and what questions would arise in my mind as to the causes that led to the steel working into such shape. On the next job we would try shellac, take the work off, find it in the same shape—and, worst of all, it was half a thousandth tapering, for with all my care dirt got under it. And it meant at that time a lot of lapping, for I hadn't tried anything in the lapping line then, except the regulation method of sprinkling, rubbing or rolling the emery in to charge the lap, which is as far behind as plate and fingers for holding.

The work would not be tapering all the time, but how many times have I looked at a shellacked piece of work with a shudder over the possibility of a piece of dirt being under it.

But with a magnetic chuck it is all different. I think nothing of taking a piece of work off, measuring it, putting it back and grinding 0.0001 inch more off; and it is easier than lapping. I have had it disputed by good mechanics; they said it was impossible to put it back and do that. But when it is done for them while they wait for the piece it makes some of the old-fashioned workmen say "Gosh!" and walk away mad. But such is human nature.

When grinding you will get so you can tell by the sound of the wheel whether it is cutting all right. Lots of times it will take a "bite" and you will lay it to a loose spindle, so you tighten it up. The wheel comes to a stop; you commence to swear. If you had stopped to think that the man before you did a good job and you took the machine from him, in fact, waited five minutes for him to finish his job, you must have known it couldn't have been a loose spindle. Then you change the wheel and instead of truing it up properly and giving it a chance even if it isn't the proper wheel, you true it off crowning, and instead of having a million or more cutting points you have just enough to start off. Then the wheel glazes in spots or on the complete cutting circle, and the fun begins and you can gamble that that wheel will hold its size with that glaze on it. When a wheel glazes it will look when it is cutting as if it was sinking into the work; but did you ever stop to think of the steel swelling because of the heat due to the glazed wheel raising the surface and increasing the sparking?

It is a pretty massive piece of metal that will stand a cut 0.002 inch in depth with a free cutting wheel without permanent distortion. A cut that deep on cylindrical grinding means good cutting with lots of water, but water in surface grinding has no effect so far as keeping strains out, but is good on cutting edges to keep the heat low. With a free cutting wheel a

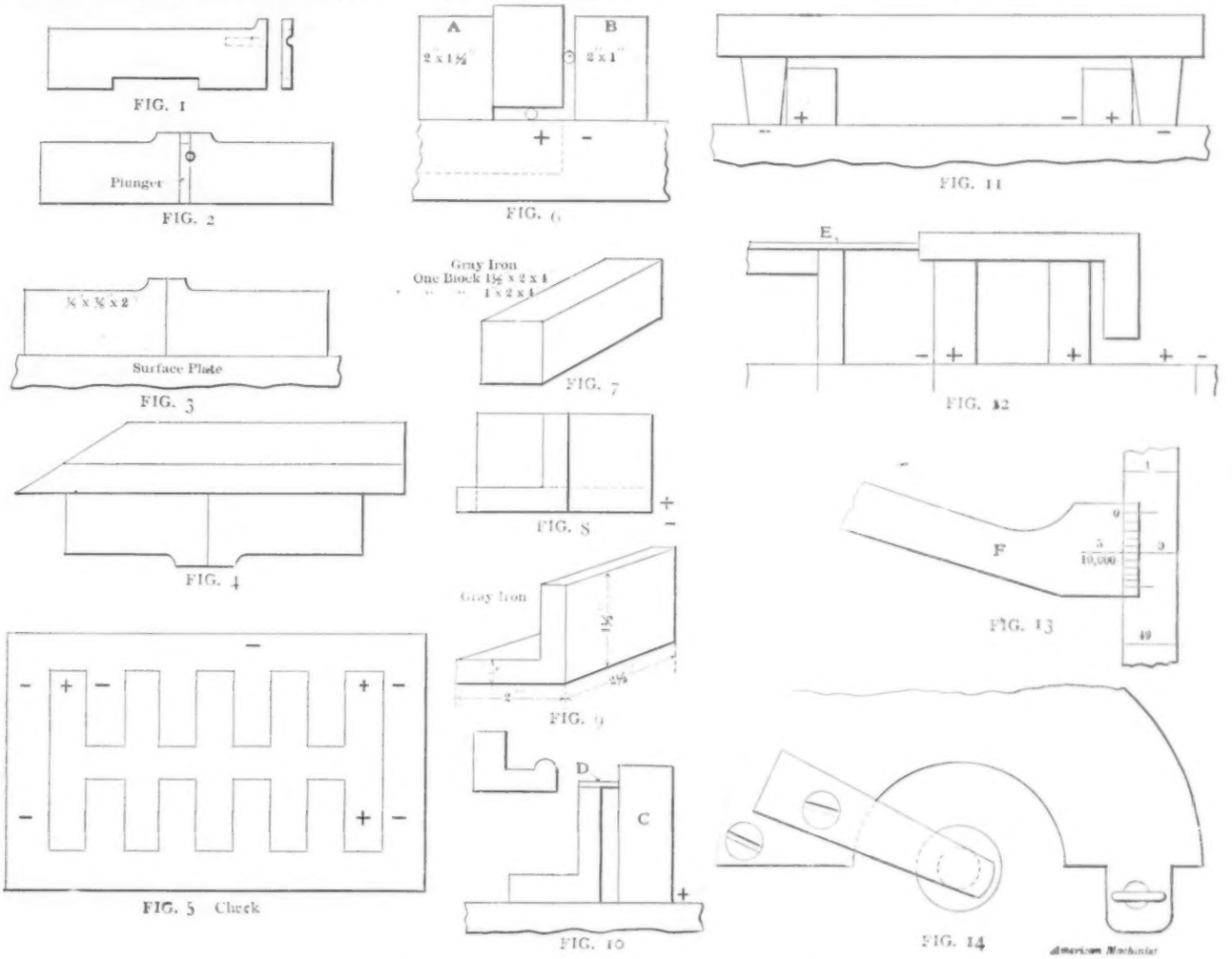
magnetic chuck will absorb and dissipate the heat fast enough on thin work.

We have no trouble in holding without distortion thin pieces like Fig. 1, which are finished 0.045x.75x4.5 inches and have only 0.00015 inch left on all sides to lap clean of wheel marks. And they have to be square and parallel, as they are for type mold plungers. Now to make the job a little easier we have to bring the surfaces so that the round nick at the end, which is part of a 0.095-inch hole, comes a certain depth and hight respectively from the face and bottom and parallel with the latter. The rest of the hole is in a water jacket, Fig. 2. This forms the nick in the type—

Fig. 5 shows the + and — poles of the magnetic chuck. It is well to remember that the surface having the greatest area of contact determines the way the work is pulled by the magnet. Fig. 6 shows an end view of a job lengthwise of the chuck. This is a fine way to square up parallels or similar work using a block *A*, Fig. 7, as a back rest and placing it so the block *B* is on the — pole with a piece of drill rod under the work and another piece between work and *B*, as shown. The pull is all on block *A*. Just try to pull it off and see if you haven't confidence in it. You can use this on the ends of the chuck just as well as lengthwise.

¾x3⅜x5 inches. A piece ¾x¾x5 inches will stand on its own bottom without the arm on piece *D*. Fig. 11 is a jig that was so long it would stand only on the — pole and so made contact with the + pole with rough square iron in the way shown and ground the top surface without any trouble. Fig. 12 shows how to hold work on parallels, using the back contact. The piece *E* we put on and found worked better than the broad contact, as it did not have such a pull sideways; it is 1-16 thick finished steel stock.

These little tricks work well on gages or odd jobs of good grinding. In manufacturing in quantity, the chuck is the ideal



SURFACE GRINDING AND THE MAGNETIC CHUCK.

and type metal will throw a burr in a space of 0.00005 inch.

Just to show the refinement in testing these for right angles, let me say they are put on a surface plate with faces together like Fig. 3, picked up and tested as in Fig. 4, and have to shut out light any way you put them together. If they do this, each is pretty near square. The water jackets placed end to end like Fig. 3 multiplied the error four and one-half times. The surfaces are squared with a knife edge square independently of each other, so we do not fit one angle to the other. The test proves the squares at the same time.

Adopting a handy thickness for block *A*, its application is very extensive. Tapers can be ground by bringing the sides parallel and using a wire for roughing one side of the taper on a master taper, then removing the wire and finishing on the master taper direct. Fig. 8 shows a pair of angle irons (of the proportions given in Fig. 9) for squaring off the ends of pieces, a piece of thick paper being placed between + and — angle irons. Use a piece of drill rod to rest the work on. Fig. 10 shows a way of blocking a high piece *C*. It requires an angle iron with a brass piece *D* soldered on which makes a good support for work bed for fixtures and boys can do good work on it and plenty of it.

Fig. 13 is a hint for machine builders. Don't be afraid to divide the thousandths into tenths on surface grinders. I have carried a piece of tin like *F* for years, have clamped it on different machines and worked to it, and it has not failed me yet in two or three thousandths of movement of the hand-wheel. Fig. 14 is a spring placed on the hood of a Brown & Sharpe No. 2 surface grinder, for taking end thrusts and giving excellent results for side-wheel grinding. It is lined with fiber ⅛ inch thick.

Don't try to lap with a steel disk, or use steel disks for a web with thin emery disks glued on; the reason is obvious.

A handy way to true up a wheel is to put the vise that comes with the grinder on to the chuck and hold your diamond holder in it.

Finishing cuts should be taken without the current on when practicable.

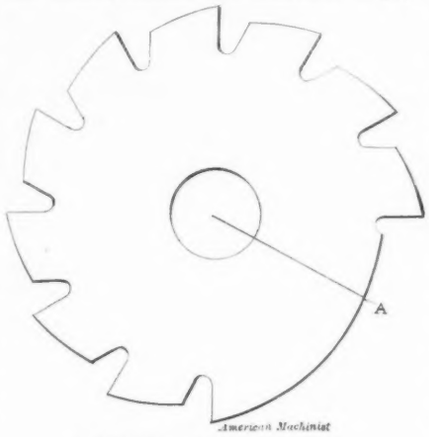
Hardened steel is the ideal for the small angle irons and parallels; emery does not bed in them so. Keep the brush off of the face of the chuck; it charges with emery and cuts the babbitt insulation. Use your hand or a piece of waste. Use a flat stone to take out bedded emery; rub lightly and a small piece of emery will feel like a solid shoulder.

SCOTTY.

Relieving Milling Cutters.

Editor American Machinist:

At page 1030, Geo. J. Lavigne shows a lathe attachment for relieving milling cutters which may be a good thing for cutters which are not designed to produce a formed surface to gage. A cutter such as Mr. Lavigne shows is usually required to produce a good formed surface the profile of which will not be changed as the cutter is ground back. In the sketch I have drawn a twelve-tooth milling cutter with nine teeth relieved as they would be by an attachment such as spoken of and one tooth I have made, to illustrate my meaning, the width of three ordinary teeth. It will be noticed that when this large tooth



RELIEVING MILLING CUTTERS.

is ground back on the cutting face on a radial line (see *A*) it has lost most of its clearance and has, naturally, also changed its shape. Any attachment for relieving cutters which will not permit the forming tool to be always in the same relation to the true center of the cutter which is being relieved will never produce a formed cutter which will stand grinding as it should be ground (radially) without changing at every successive grinding both in clearance and in form.

Mr. Lavigne says, "It can do the same work that the large and more expensive machines can do, and do it as well." This is manifestly wrong, as we all know that the formed milling cutters which are made by a relieving machine will produce the same results throughout the whole life of the cutter, because the clearance is produced by a cam movement in connection with the cross-slide of the machine, the cutter constantly rotating upon its true center and the face of the forming tool also being set upon the same center line. This is written simply because I have learned the truth of my statement by sad experience, having once made a formed cutter and relieved it by swinging it eccentrically in the lathe and I wish to warn others lest they thoughtlessly do the same.

C. UTTER.

A Fixture for Turning Eccentrics.

Editor American Machinist:

Seeing at page 601 of your valuable paper a mandrel for turning eccentrics, I thought it might interest some of your readers to learn how we turn them in our shop.

We used to turn them in the lathe, and when a man did three in one day it was considered a good day's work, while with the fixture shown in the accompanying illustrations one man can turn out eight or nine in a day easily; of course this does not include the planing and drilling—the eccentrics being in two parts.

Fig. 1 shows the fixture itself. It is a disk of gray iron 3 inches thick and about 19 inches diameter, with a hub *a* which fits into the center of a vertical boring-mill table. The four holes *b* near the edge are for the holding-down bolts, and pockets are cored out from the top to receive the nuts so they will not project.

The six circles or rings are for the different throws and range from 4¾ to 6 inches throw. In each is drilled and tapped a 1-inch hole which is counterbored 2 inches diameter and ⅞ inch deep. These holes receive the boss turned on the bottom of the plug shown in Figs. 2 and 3, the plug having two drilled and counterbored holes *c c*, one of which coincides with the hole in one of the other circles, while for the other a hole is drilled and tapped specially. Two 1-inch bolts go thru the plug and screwing into the tapped holes hold it firmly to the fixture.

The eccentric is slipped on to the plug and clamped down on two blocks (not shown) which act as parallels and hold the work high enough to allow the tool plenty of room to run down and a shovel nose to be fed in sideways to form the tongue. The bolt which clamps the eccentric screws into the tapped hole *d* in the center of the plug.

Fig. 2 shows an eccentric on the fixture and in position to be turned. It will be seen that the plug is on the smallest circle,

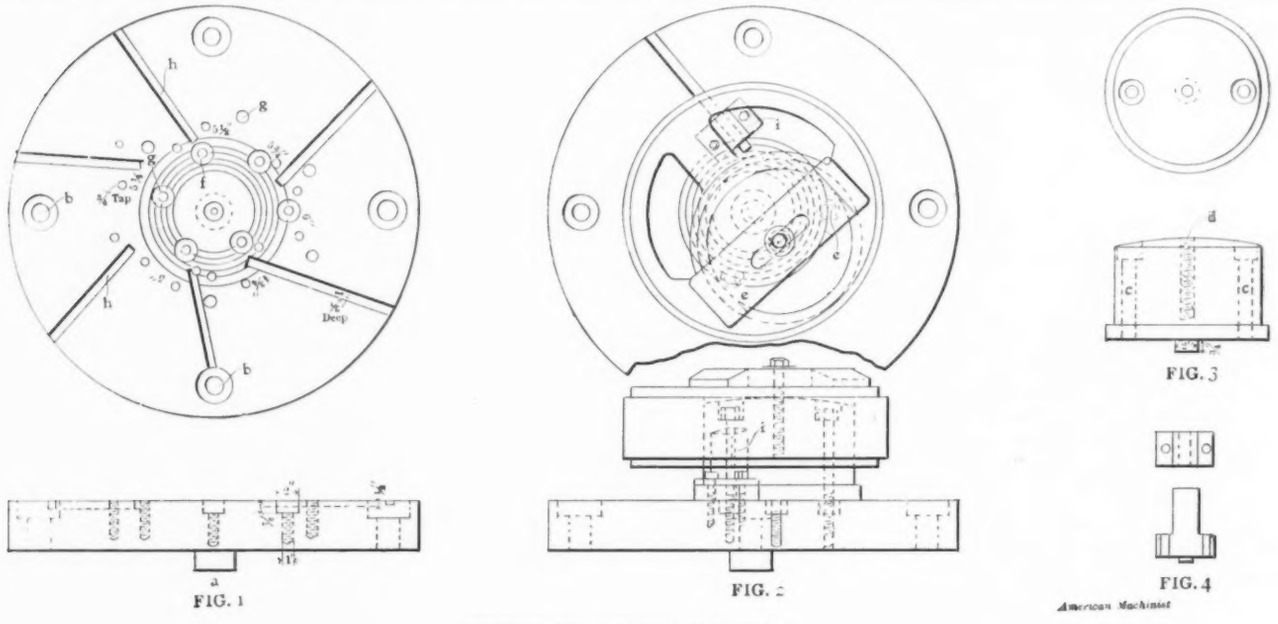


FIG. 1 FIG. 2 FIG. 3 FIG. 4

FIXTURE FOR TURNING ECCENTRICS.

which is 4¾ inches in diameter, consequently making a 4¾-inch throw, the eccentric being trued up on the machine before being clamped tight, and the plug being held by the two bolts *e*, one of which is screwed into the locating hole on the 6-inch circle. If we have an ecentric with a 5½-inch throw, we locate the plug by hole *f*, Fig. 1, and the two holes *g* will then receive the bolts for clamping the plug to the plate—and so on all around.

The six slots are for the block *i*, Fig. 2 (shown in detail in Fig. 4) which acts in the capacity of a driver; it is bolted tight to the plate by two ¾-inch bolts.

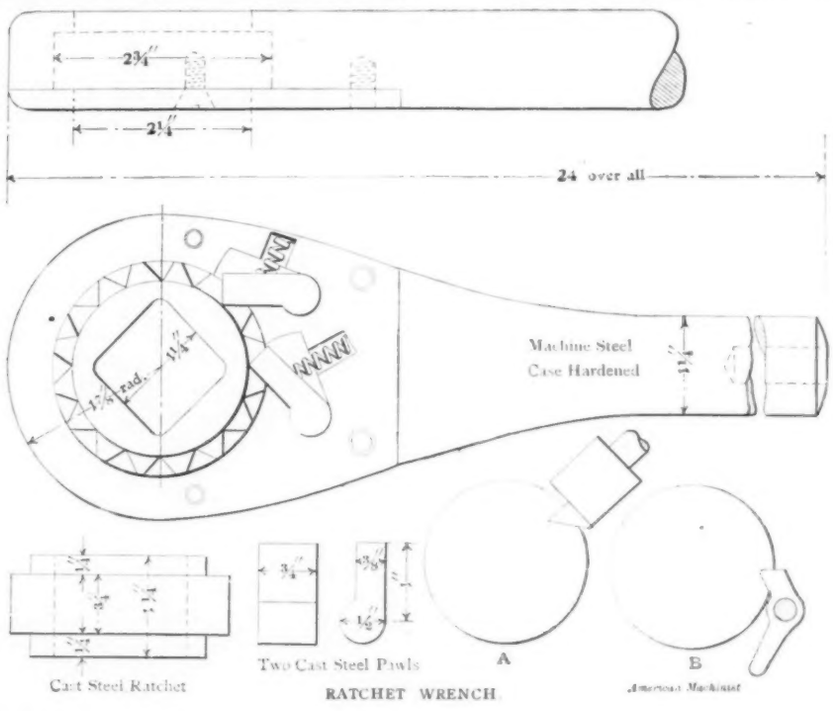
The eccentrics are first clamped or bored out and forced off to required thickness on both sides on the boring mill, when they are ready to be turned.

Providence, R. I. L. E. SALMON.

A Ratchet Wrench.

Editor American Machinist:

We wanted a ratchet wrench that would not occupy much space and yet be strong enough to resist the united efforts of two men on a five-foot handle. After a practical test of more than three years we recommend a wrench of the dimensions and material here shown. *A* shows a style of pawl and ratchet much used: the fault with this is the tendency to shear off the point of the pawl; and also, the teeth of the ratchet being sharp on the perifery, the strain is carried by the bearings on either side rather than by the teeth themselves. In our wrench, the points of the teeth being flat, we get the bearing on the teeth themselves, thus not only getting the strain immediately opposite the pawl, but by crowding the ratchet into the inside of the circle in the handle we make it practically impossible to split the ratchet wheel, especially when we divide the strain between two pawls. Also by locating in this way we get a crushing instead of a shearing strain on the pawls. The style *B* has also a tendency to shear off the pin, altho both *A* and *B* are well adapted to some purposes. We discovered that men using a ratchet preferred turning it over to manipulating a lever to reverse the pawls. We made the lever only 24 inches long as it was easier to carry about, and if a longer lever was wanted it could be extended with a piece of pipe. ISAAC MORGAN.

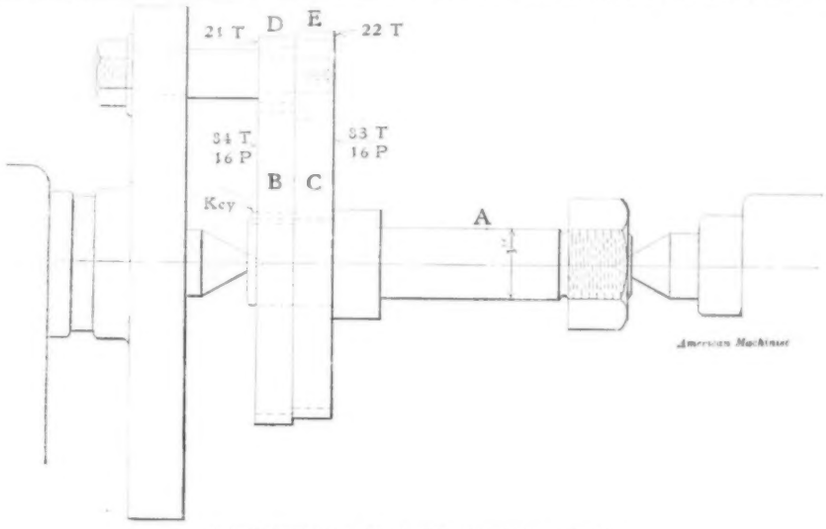


RATCHET WRENCH.

Speed-Reducing Gear for 13-Inch Lathe.

Editor American Machinist:

The sketch illustrates a device I made the other day for reducing the speed of a 13-inch lathe sufficiently to enable me to turn some hard steel castings 12 9-16 inches diameter, and cut some fine sharp grooves in the perifery. The slowest speed of the lathe is 22 turns per minute; the slowest obtainable with this arrangement 1 turn in 50 seconds.



SPEED-REDUCING GEAR FOR 13-INCH LATHE

A is the arbor for holding the pulleys while turning. *B* is an 84-tooth gear keyed to *A*, and *C* is an 83-tooth gear which is a running fit on *A*, but prevented from turning by a handle (not shown). *D* and *E*, having respectively 21 and 22 teeth, are keyed together and free to rotate on a stud bolted to the faceplate. This drive is copied from a Pratt & Whitney screw machine, but its application to an engine lathe is new, at least to me.

JOHN P. WHEELER.

An Original Way of Making a Templet.

Editor American Machinist:

Often, when confronted by a perplexing problem, I am reminded of the ingenuity of an old tinker, one of our neighbors in my boyhood days. He was a skillful worker and enjoyed the patronage of the whole village. Fall coming on, he was busy making stovepipe—this was before the days of machine creased elbows. Some way or other, one of his templets got lost in the shuffle, and, as usually happens, it was just the one he needed. This templet was a piece of flat sheet iron, showing the curve of a 6-inch stovepipe cut-off at an angle of 45 degrees.

Now, this man had never learned to make geometrical drawings, and knew not how to lay out a new templet and get it right the first time; but he was not at his wit's end evidently. He cut his sheet iron the proper length, bent it up and creased it into a respectable-looking, straight stovepipe. The question how to get his miter properly he solved by measuring back from one end a distance equal to the diameter and marking the spot with chalk. He then turned the pipe half way around and made another chalk mark at the end of the pipe close to the edge. Next he went for a pail of water, upon which he squirted a little oil and after the surface had settled he slowly stuck his pipe into the liquid so that both chalk marks just

touched it. Then he withdrew his pipe and cut the wet part off and proceeded as usual. CONTRIBUTOR.

A Die and Bender for a Small Steel Bracket.

Editor American Machinist:

The appliances illustrated in Figs. 1 and 2 for making a small wire bracket may interest those who have similar little difficulties to overcome.

The finished bracket which is seen at *A*, Fig. 2, is used for carrying the wings of a transformer windmill and is made from 3-16 inch round steel.

The job was given to the smithy foreman, as being the most likely person to do it, and after muttering something about draftsmen and managements generally and eyeing the blueprint from all points of the compass for a day or two, he consulted the toolroom foreman, and between the two the die and hand-bender, after a series of experiments, were gotten out to do the job satisfactorily.

The area of the wire in the bracket is only slightly in excess of the area thru *B*, and in order to produce the section clean and square, no drawing of the material must take place.

An impression is cut in the tool-steel block, as shown in all three views in Fig. 1, and in such a manner that the grooves on either side of the flat part are a tight fit for the wire. Unless this precaution is taken, the result is a failure. The material is cut into correct lengths, then laid in a small furnace (preferably gas) and brought to a bright red heat. The die is fixed in a press or to a fixture—as a smart blow from a sledge is found to be sufficient. The pieces are placed in the groove and up against stop *C*, and pressure applied or a blow struck on the cap *D*, which is guided on two pins and supported by light spiral springs, and the operation is finished.

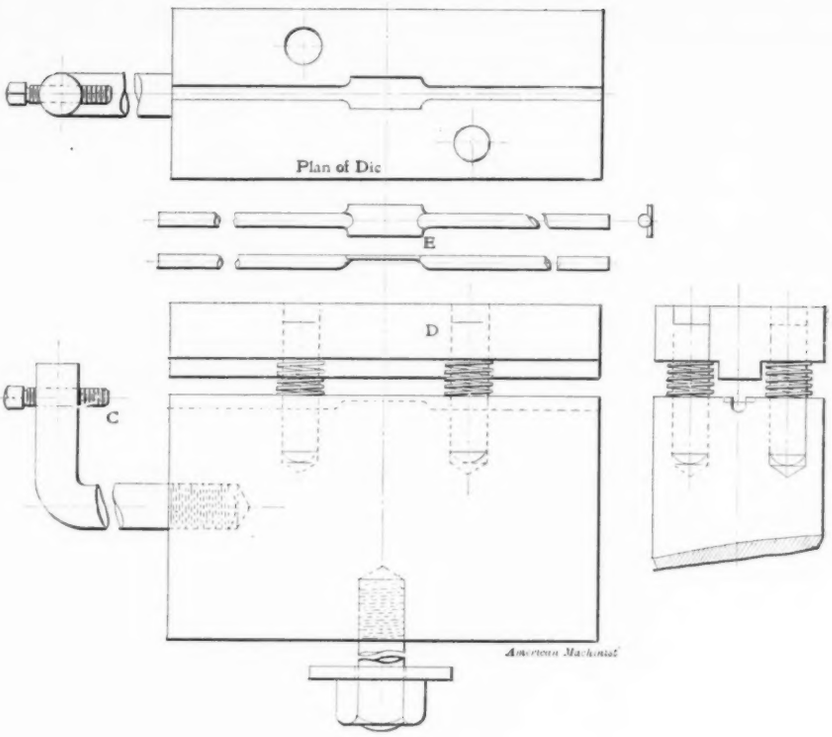


FIG. 1. THE DIE.

If the die is well oiled there is no difficulty in lifting out the piece, which cools very rapidly. *E* shows the piece after the first operation.

The bender, Fig. 2, consists of a tool-steel former *F* held by two countersunk head screws and two dowel pins to the gray-iron plate *G*. The bending levers *H* are pivoted in the plate *G*, as will be seen in the section of the lever at *a a* and in correct relation to the corner of the former *F*, the levers being kept in place by the former covering their pivots. The levers *K* are pivoted on the levers *H* in such a manner that they also swing into the right position in relation to the former *F*. A section thru *K* is shown at *b b*.

The levers, in full lines to the right, are in position before bending, with the piece in place, the levers in dotted lines showing the position after the first bend has been made.

The levers to the left are in the positions they occupy when the bending operations at that side are completed. The

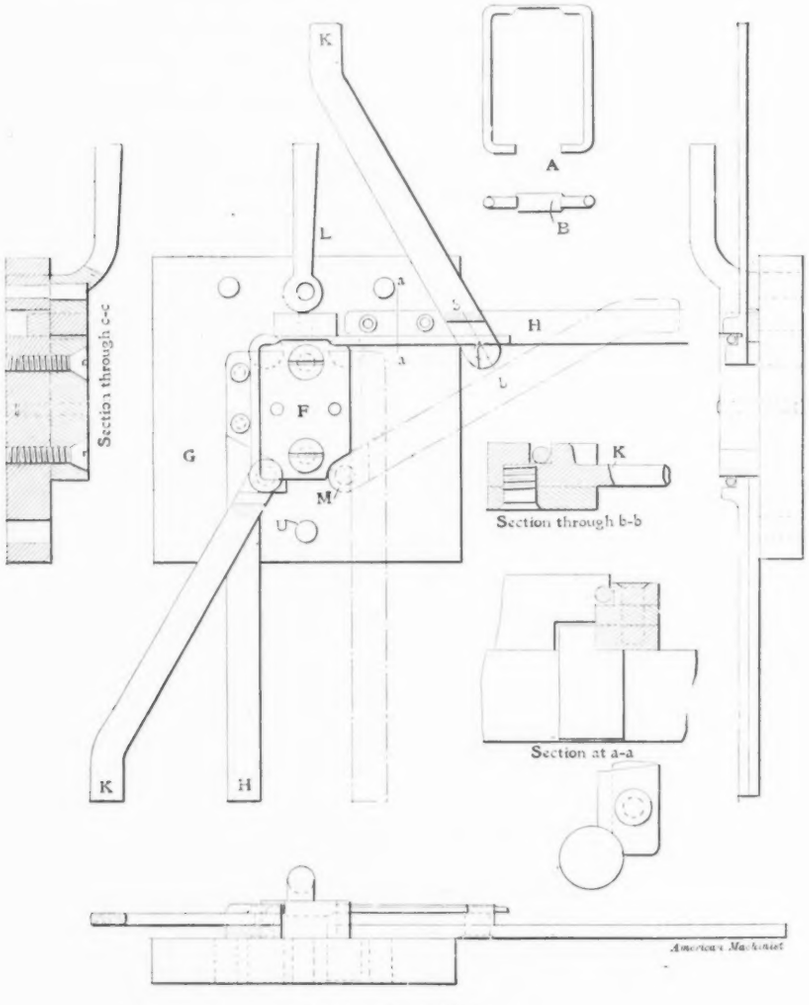


FIG. 2. THE BENDER.

piece is bent cold and the action is as follows: By means of the flat part *B* the piece centers itself on the former *F* and is held by the cam *L*, the ends being along the levers, which are both in their open positions. By operating levers *H H* at the same time the first bend is formed on either side, and by the same movement the levers *K K* are swung into working position, as indicated by dotted lines at *M*. The levers *K K* are then operated, making the second bend.

The cam is released and the finished bracket lifted out. The levers are then thrown back for another operation.

WM. F. HOFFMANN.

Tool Block Planing Fixture.

Editor American Machinist:

An unsatisfactory job of planing without a special fixture is shown in the tool block, Fig. 1. On account of the big lug *L* being 3 inches high, the job had to be set upon blocks as in Fig. 1; the top side and the two sides were then finished. The clamps were then placed as in Fig. 2 before the first clamps were removed, in order that the job might not move. The angles were fitted next and there was always danger of the job shifting. The above method of course was very slow, as only one block was done at a time. This method was used only on the first lot of machines turned out, then the fixture shown in Figs. 3 and 4 was made. Tho very simple and cheap, the great saving of time effected over the old way will be apparent to anyone familiar with planer work. The fixture has holes bored in it properly spaced to fit the lugs *L* of the tool blocks. The lug and face of the block are first finished in a lathe, the hole for the screw being also tapped out. A screw is run into the tapped hole, the lug is dropped into the hole in the fixture and the open collar, Fig. 5, is slipped over the screw; then the block is lined sideways and the screw is tightened up and holds any cut put on. The fixture is made in two sections to make handling it more easy, and each section holds three tool blocks. The top has four ribs on it to save planing and make the appliance lighter. The fixture allows the job to be finished in one setting. It is in use at the shops of the American Turret Lathe Company, Warren, Pa.

CAMERON.

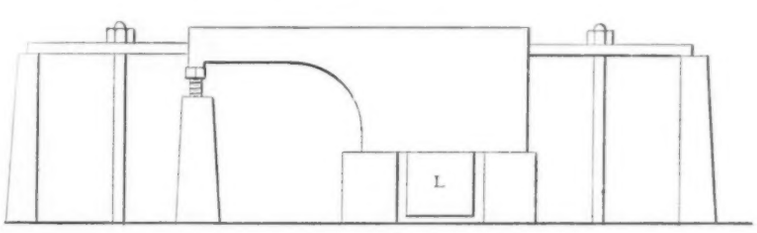


FIG. 1

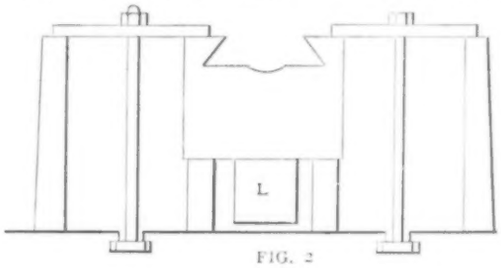


FIG. 2

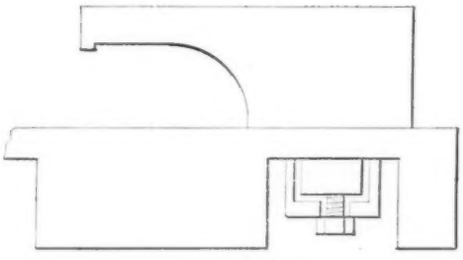


FIG. 3

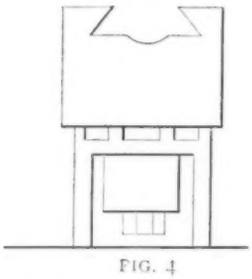


FIG. 4

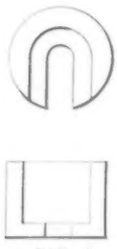


FIG. 5

TOOL BLOCK PLANING FIXTURE.

Breaking in New Machine Tools.

Editor American Machinist:

Osborne's article on perfection, at page 1186, strikes a responsive chord in me. Was Osborne's lathe hand as near perfect with the oil can as the fits on the apron studs were?

I suppose that there is more machinery put "on the bum" by lack of oil than by any other cause. I don't doubt that there are cases, and lots of them, as narrated by Osborne, altho I have limbered up a good many new machines and, with two exceptions, I have never had a particle of trouble. I know that in lots of places it is not only unnecessary to make such perfect fits, but that such fits cause trouble with the man who is responsible for the delays for repairs. The proper choice of oil is, I think, quite an item in any case.

I am working for the government, and I have found here the difficulty with new machinery has been not in its being too near perfect but too far from it. One of the leading machinery builders in the United States sold the government multiple spindle drill presses having stationary spindles and elevating the table for feed by either a hand or a foot lever. These drill presses were tested by me and found to be from 10-1000 to 15-1000 inch out in a 10-inch circle. These presses were to be used on rifle parts, where the limit of error was small indeed, and in some places no discoverable variation whatever was allowed, and the reader will appreciate that things had to be about right to get the results desired.

I took the table off the knee, on which were four round bosses, and found that if these bosses had ever been machined at all, the erecting mechanic (?) had filed them so that when a straight-edge was put on them there were places where the straight-edge lacked nearly 0.01 inch of touching the boss; that is, the straight-edge would rest on the edge of one boss and on the middle or opposite edge of the next one, and so on.

Well, I put in several hours on each of the four presses before I got them right. They are not out now over one-half of one thousandth.

The government bought three tool-room shapers and they were furnished with dust-proof oil cups, which were oil-proof as well. The holes in them were about one-half as large as an oil-can spout, and when one made an attempt to oil up, most of the oil ran down the outside of the oil cup instead of the inside, so that one would not only fail in what he was trying to do, but would get oil all over the machine. One of the machines stuck, and in getting it apart the shaft and both bushings were ruined. The oil cups were taken out entirely, and since then we have had no further trouble.

One more and I'll quit. We have about 600 "Lincoln" millers, and before we could use them it was necessary to bore 5-inch cannon balls and put them on the drop shaft of the machines, as without this weight, when the dog on the table released the catch that held the worm in mesh, it failed to drop. Of course the weights have been put on only about 100 of the machines as yet, as they are not all in use.

As a precautionary measure we put

positive stops on the tables, so that if one should happen to over-run, the stop would prevent the spoiling of work and perhaps the spoiling of the fixture also. These stops were put on with two ½-inch cap screws, and in spite of all our pains one of the machines ran by and sheared the cap screws off as tho they had been straws. I was called over and took the machine apart and found that the spring (a coil spring) that operated the trip was so tight a fit on the rod, and also in the hole, that its use as a spring was *nil*. And yet that same concern makes a toolroom lathe equal to the best and better than most.

GEO. HALEY.

A Facing Job in the Lathe.

Editor American Machinist:

A number of castings like Fig. 1 had to be machined on the sides *A* to the thickness shown. Planing was tried first, but the time taken was too long and the results unsatisfactory; so the tool-holder, Fig. 2, and the chuck, Fig. 3, were made, and both sides of the casting faced down in the lathe at one cut, reducing the time on the job to less than half that required

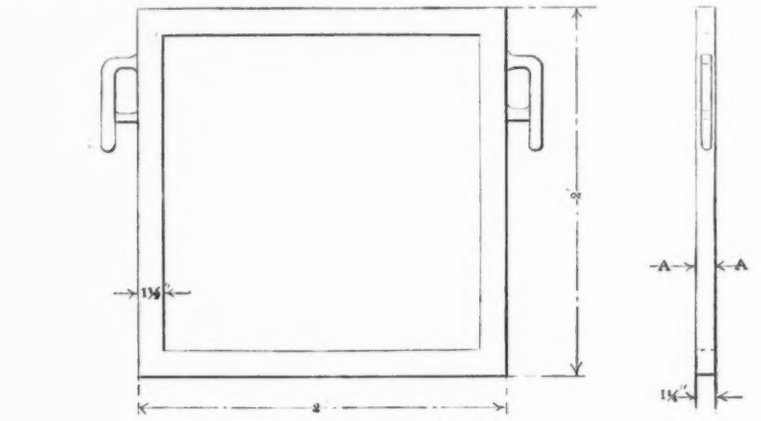


FIG. 1

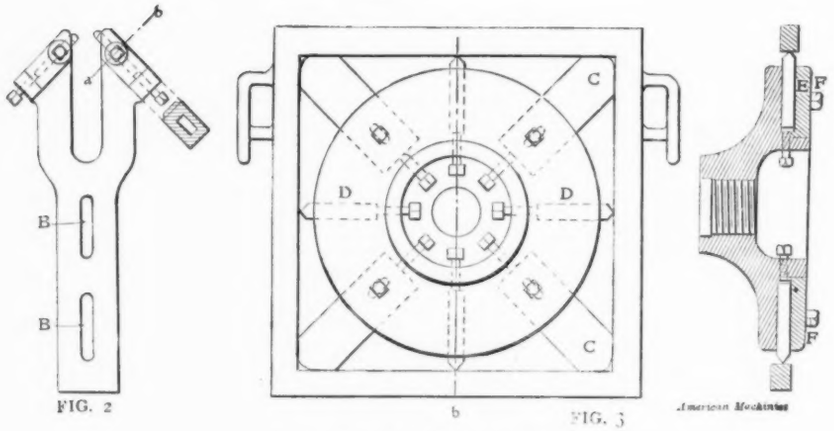


FIG. 2 FIG. 3

A FACING JOB IN THE LATHE.

in planing them, and resulting in better work.

The body of the tool-holder is of gray iron, with slots *B* cored to facilitate clamping down in the tool-rest. The holes for the tools are cored in 1¼x⅝ inch, and two ⅝-inch set-screws are tapped in to lock the tools, the two other ⅝-inch screws adjusting them to depth of cut.

The chuck, Fig. 3, shows a piece of work in position, ready for facing. The body of the chuck is of gray iron and threaded to fit the lathe spindle. It is planed out to receive the four rectangular steel pieces *C*—3½x1 inch—which act as drivers, and is drilled out to take the four 1-inch steel pieces *D*, which are pointed on one end, and are just screwed up lightly by the set-screws shown into a center mark in the casting, which sets it at once. When the screws are set up, the plate *E* shown in section locks the lot together by means of the four screws *F*, as shown.

Newport, England. J. WHEELER.

Two Makeshifts.

Editor American Machinist:

A couple of elevator constructors were cutting out a 12-inch I-beam as a preliminary to an elevator installation. Their hacksaw, with throat 10 inches deep, ordinarily good for a 19½-inch depth cut by frame reversal, could cut only 10 inches, owing to the flange of the I-beam abutting on concrete (see Fig. 1). As they were nearly thru the 10-inch cut, I awaited developments. Fig. 2 amply rewarded me for my patience.

The clamp (begged, borrowed or stolen for the occasion) was an exceptionally large one. Screw *A*, when tightened up in conjunction with suitable wood brace *B*, tends to draw the lower portion of the clamp together, thus tightening the blade. Screw *C* is screwed in very lightly, as its function is merely to keep the clamp jaws

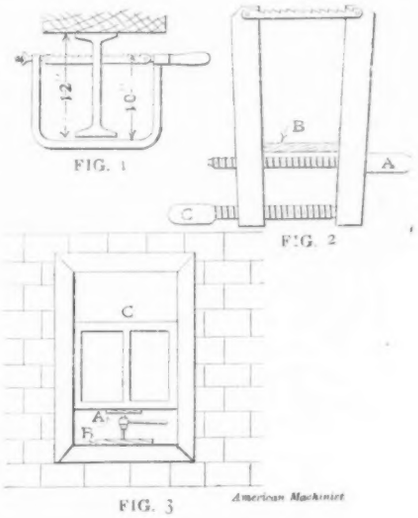


FIG. 1 FIG. 2 FIG. 3

TWO MAKESHIFTS.

from swinging sideways out of alinement. Two small nails held the 12-inch hacksaw blade. The rig was run by two men and worked like a charm.

A couple of iron-workers, having to drill some ⅝-inch holes on a job, had brought a ratchet and drill, but had forgotten a drilling post. Fig. 3 shows how, turn and turn about, they used a window sash as an "old man," one working the ratchet while the other sat on the frame. Of course they could have put a brace between the sash and the top of the window frame and used the ratchet feed screw. *A* is a piece of iron for a center. *B* is the plate being drilled. *C* is the window sash.

CHAS. HERRMAN

Casting Bronze Upon Iron.

Editor American Machinist:

In answer to B. H. B.'s inquiry at page 1034 as to casting bronze or other hard composition in gray-iron boxes, would state that I have had considerable experience in that line and never had any trouble.

Get a core the size of the hole wanted—that is, before boring out—then get the gray-iron box and set it on end, take the core and set it up inside, leaving the space required for metal. Take two pieces of wood the thickness of the space and length of the box, place them one on each side of the box, extending about ½ inch out from the center of the bearing. Then put a box around the core and casting. Ram sand around them, draw the strips out, and cast the metal from the top. The box must be heated as hot as possible and cast as soon as ready with hot metal.

Some firms make their boxes a little over the center so that will do away with the strips mentioned, as they are only for planing strips.

THOS. WATHEY

Rig for Making Tapered Wooden Pins.

Editor American Machinist:

The wooden tapered pins shown in Fig. 1 were wanted in fairly large quantities. Figs. 2 and 3 show the tools we set up

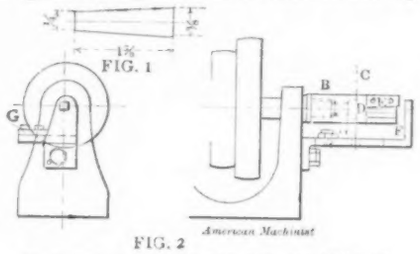


FIG. 2

THE PIN AND THE RIG FOR MAKING IT.

for making them. The wood came from the saw in square strips about 2 feet long, the sides of the square being a little larger than the large diameter of the pegs. The filling up washer *B* was screwed on the spindle nose of a wood-turning lathe, the saw *C* being gripped between it and the holder for the blade. The holder *D* is coned to suit peg, to act as a stay, against the pressure of the cut. The blade *E* was put forward of the center to obtain a rake. When working, the end of the strip is pushed thru the square hole in *F*, which prevents it from turning, with the cutter which cones it. It is then pulled out and cut off to the correct length by the saw, the end being pressed against stop *G*.

H. M.

Is the "Practical" Man in Danger?

Editor American Machinist:

I have just read with much pleasure Dixie's letter at page 1037, in which he exposes the "appalling ignorance" of a certain unmechanical engineer, a graduate of an engineering college, who at thirty years of age had a position with a salary of $1,800 a year. I am also a graduate of an engineering college, but am past fifty years of age and graduated more than twenty-five years ago, yet I have to confess my "appalling ignorance" of some of the things which Dixie seems to know. I quote: "I had an order for a stamp which was to fall 5 inches and strike a 300-pound blow. When I asked Robb to work

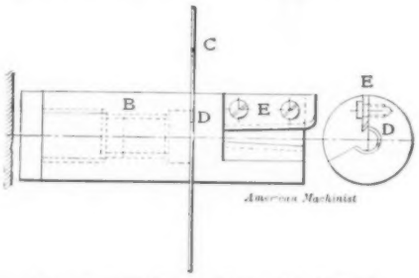


FIG. 3. DETAIL OF SAW AND CUTTER.

it out for me (I had previously ascertained the size and the pattern for the weight was in the foundry) he cocked his head on one side," etc. What I am ignorant of is how Dixie "ascertained the size." Will he be kind enough to tell us?

Your "Letters from Practical Men" are exceedingly valuable, but the best ones are those that convey useful information to other practical men, and not those that merely criticise the "appalling ignorance" of a few individuals.

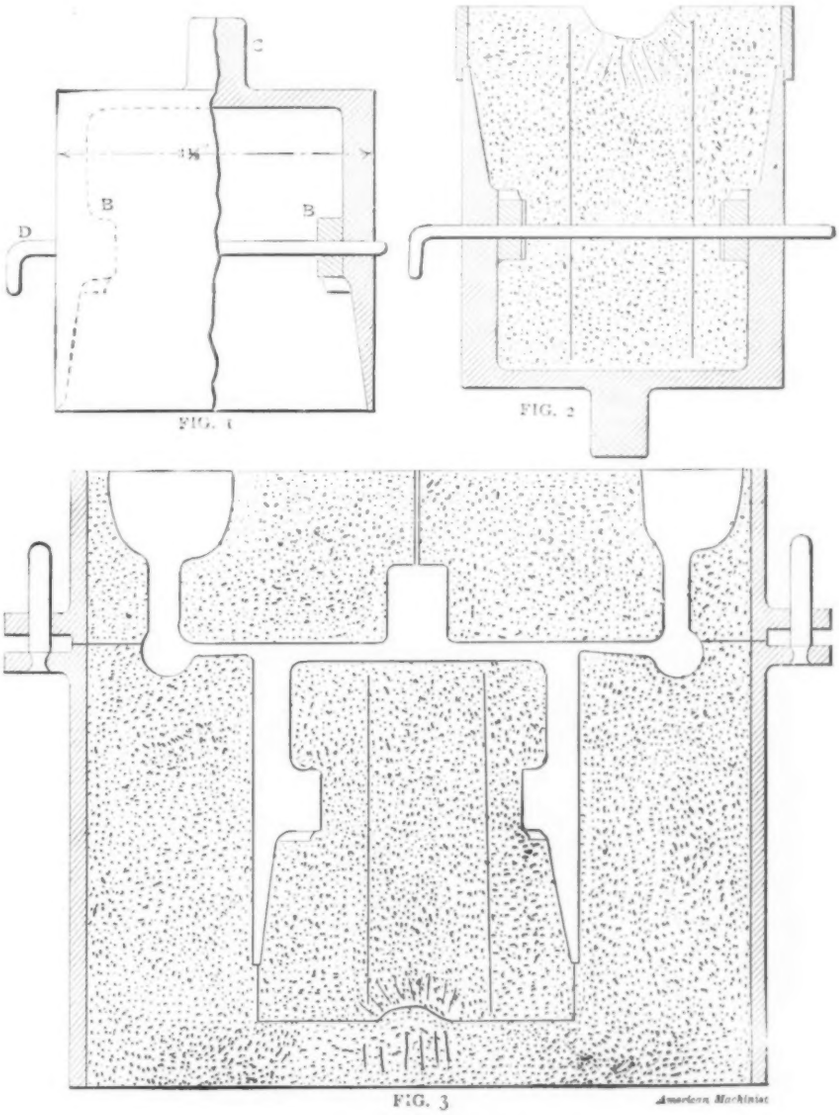
GRADUATE.

Molding Small Motor Pistons.

Editor American Machinist:

The metal pattern for a motor piston is shown in Fig. 1. This pattern is complete in itself, no additional core box being required. The rod *A* passing thru holes drilled into the sides of the pattern serves to hold the bosses *B B* in position while ramming the inside. This method of preparing the pattern is no doubt good, having the advantage that when the inside and outside are thus made together a casting with an equal thickness of metal is obtained. It is, however, a somewhat slow process to mold it, as three-parted flasks must be used, and to insure sound castings the inside green-sand core must be carefully vented and dried a little with hot plates.

To hasten production and at the same time use the ordinary two-parted flasks the pattern was fitted with a loose ring about 1 inch deep as shown in Fig. 2. Cores were made in the pattern itself with this ring on, and these were well rapped so that they would go back easily. When molding by this method the pattern without the ring is set on a suitable board with a hole in its center to receive the boss *C* (this boss is cast on the piston for convenience in turning). The core is next dropped into its place in the pattern and the drag is rammed up and turned over, and the mold is finished off in the usual way. When the pattern is drawn it is found that all that remains to be done is to cut gate and riser. Fig. 3 is a section of the mold complete. The saving effected by using the pattern as last described is 50 per cent., as the cores are simple to make, a boy being able to make five dozen per day. The standard sizes of these pistons are now made four in a flask; good, sound castings being usually obtained.



MOLDING SMALL MOTOR PISTONS

GEO. BUCHANAN.

London, England

Planer Stops.

Editor American Machinist:

It's often said a casting or machine is no stronger than its weakest point. That rule surely holds good in a planer stop. You will generally see these stops turned down at one end with a sharp corner at the shoulder and the top part anywhere from ⅛ to 1 inch larger in diameter. If they were made a foot in diameter above the turned part they would be no stronger at the sharp corner of the shoulder (*A*, Fig. 1).

It's foolish to use stops standing over 4 inches above the planer table, tho you sometimes see them lying around 6 or 8 inches high and bent in fine shape. A job requiring a stop over 3 or 4 inches high should be blocked with an angle-plate or something to hold it firm, so that it will stand for a good cut without any chance of moving.

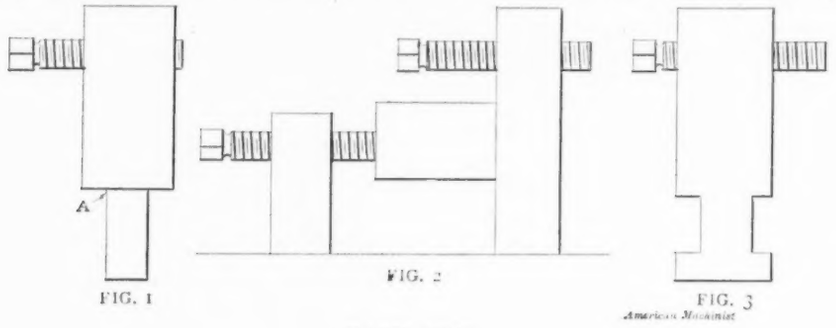
Fig. 2 shows how a long or high stop can be stiffened by placing a short one behind with a piece of metal between. It is annoying to a neat workman to run into a lot of stops all bent up and unfit for use, when in a hurry. The cheapest and best stops for a planer are made from cold-rolled stock tapped out for a set-screw. Two or three lengths will answer the purpose better than six different lengths with a shoulder on, because they can be set up or down in the holes to suit the job. The set-screws should be an easy fit, so that they can be run in and out quickly with the fingers.

The holes in the planer table should be reamed out to a fit, making it unnecessary to use a pinch-bar to pry the stops out, breaking and bending the set-screws in the process.

Another very handy stop, and one to use in the slots when the holes don't come just where wanted, is made from square cold-rolled stock to fit the slots, and can be swung over to one side to bring it to the hight wanted. It is best that such stops lean from the tool, however, then should the job move, the tendency would be to draw down, while if turned toward the tool, the job might lift.

Slot stops made as in Fig. 3 give but one hight and must be slid in from the end of the slot. When made straight, they wedge tight when the screw is drawn up, and there is no need of having a T-head on them.

CAMERON.



PLANER STOPS.

A Screw Machine Chuck.

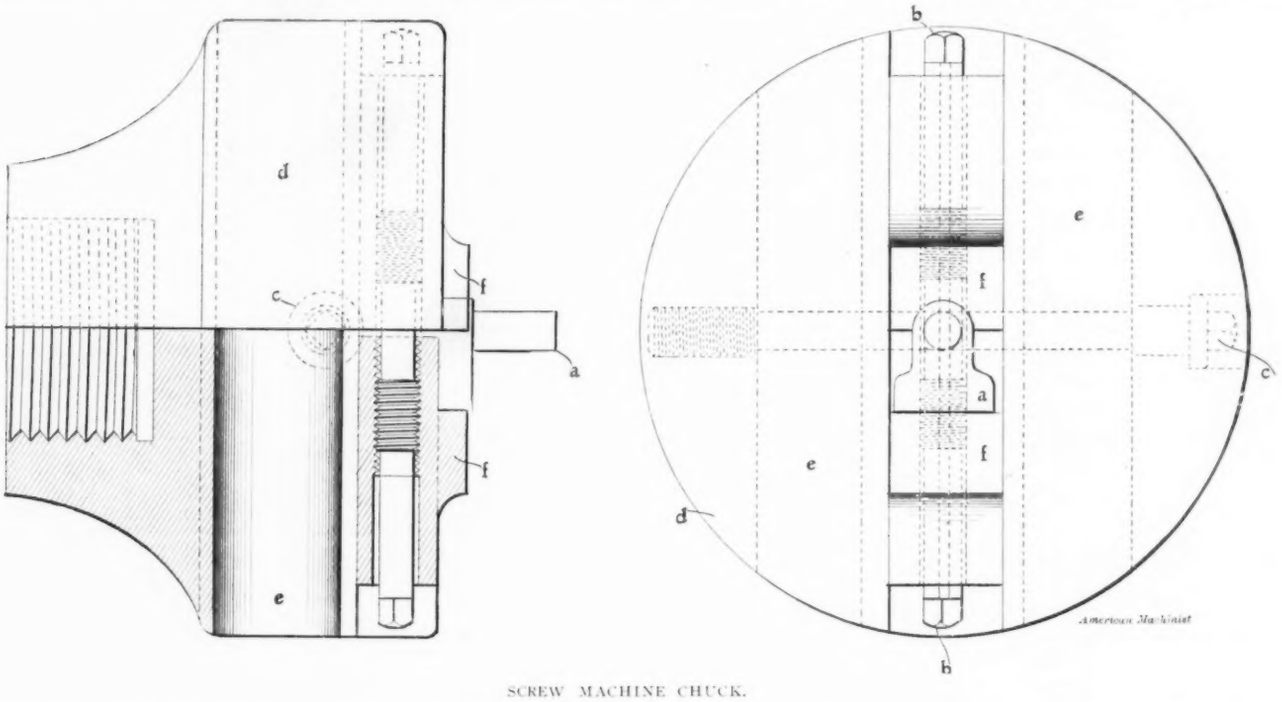
Editor American Machinist:

In the accompanying drawing is shown a screw-machine chuck made for finishing the end of piece *a*. This piece is drop-forged to the proper shape, and the only portion to be machined is the stem, but this must be turned perfectly central. This is accomplished by placing the piece in the chuck and tightening up from either end the screw *b*, the central position being obtained by bringing a female center in the turret up against the stem. When central the screw *c* is tightened to hold the work and jaws in position.

The chuck body is made of tool steel and finished all over. One end is threaded internally to fit the screw-machine spindle and the face has a 45-degree dovetail slot planed across it, the stock at the bottom of this being split the whole length, after the center of the body *d* is drilled out as shown in the section at *e*, to form an elliptic opening and give the chuck a spring tension. The hole drilled for ram *c* is countersunk at one end to fit the head of the screw and threaded at the other. The chuck is now hardened in oil and drawn to a spring temper, and the dovetail is lapped straight at the bottom and sides, by means of a gray-iron slide to fit, and by adjusting with screw *c* until a perfect surface is obtained.

The jaws *f* are also made of tool steel, hardened and lapped. One is planed off at the top to fit the piece *a*, and the other bored and slightly tapered on the face to hold the work firmly. At the center they are tapped right and left to fit the screw *b* and the ends of the holes are counterbored to remove some of the thread and allow an extension to be used when tapping.

A. L. MONRAD.



SCREW MACHINE CHUCK.

An Inexpensive Pattern and Set of Core Boxes for Face-Plates.

Editor American Machinist:

We recently had occasional demand for large, light face-plates for gap lathes. These plates ranged from about 30 to 48 inches diameter and were liable to be of any intermediate size. We could not get money enough for each one to much more than pay the cost of the casting and machining. As it was pretty certain that there would not be many orders for any one size, it was left to me to get out the patterns for next to nothing. The method we used was very simple but answered the purpose well. We got out a flat disk 48 inches diameter and 3 inches thick plus sufficient for finish and shrink. This was glued up in segments to make a permanent job. Loose hubs as *a*, Fig. 1, with loose core prints were made to suit each job. This plate was bedded into the sand hub up and a cope rammed up. This cope, it will be seen, was flat except for the hub and print. The cope was lifted off and the pattern drawn, leaving the lower print *b* in place. Over the projecting dowel of print *b* was laid a centering piece 6 inches in diameter made of a piece of 7/8-inch board. This was to set the cores against and was of course taken out together with the lower core print after the cores were in place.

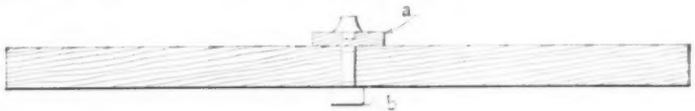


FIG. 1

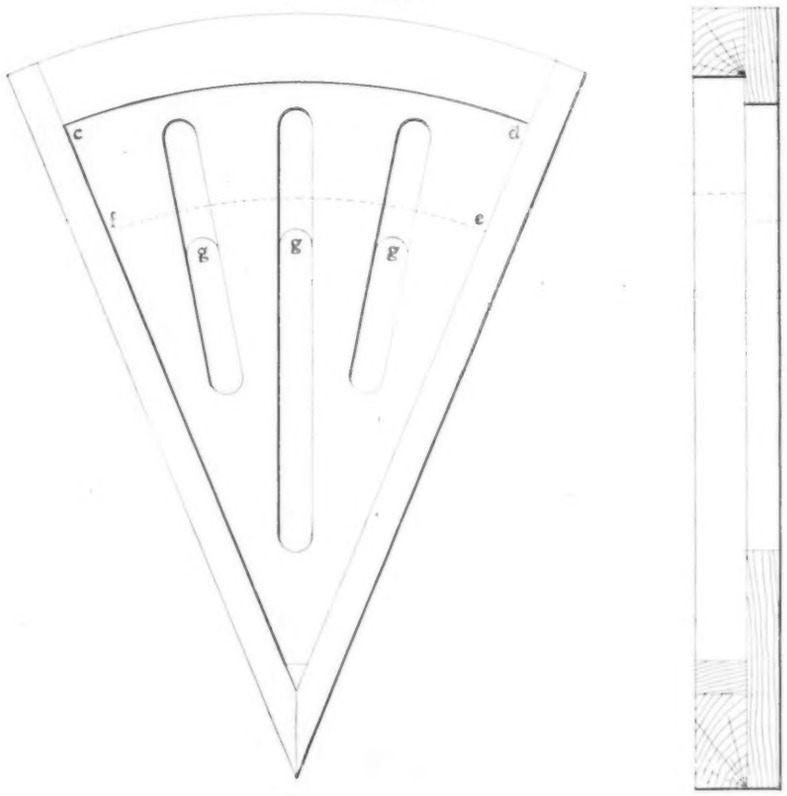


FIG 2

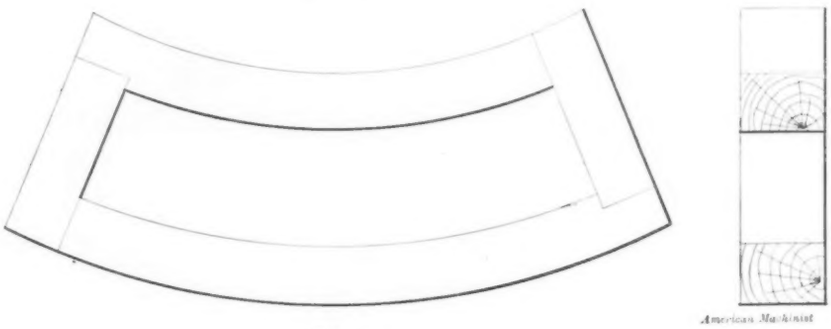


FIG. 3.

FACE-PLATE PATTERN AND CORE BOXES.

So far everything was done the same for all sizes. If we were making the 48-inch plate we had eight cores made from the box shown in Fig. 2. The eight cores, if laid touching the 6-inch circle in the middle, would leave ribs of about 1 inch thickness between them and the same plus finish on the rim. The projections for the slots were used to set the core on and their hight determined the thickness of the face of the plate. The whole thickness of this core was equal to the thickness of the pattern in Fig. 1, so the cope bore on the cores and held them down. The cores were vented into the cope.

If we wanted a smaller plate, we made a piece shaped as shown by *c d e f*, Fig. 2, to lay into the core box. To the bottom of this place were fastened three pieces to fit into the slots and cut them off down to the dotted lines *g*. To cut off the outside of the plate a core box, Fig. 3, was constructed and eight cores made which were set into the mold around the rim to cut the diameter down to suit. Three pieces—the loose hub, the stop-off piece in the core box, Fig. 2, and the core box, Fig. 3, were all that were needed for each new size of plate.

PATTERNMAKER.

A Workman's Spite?

Editor American Machinist:

During my travels I once worked for a large concern in England, and among other big things they had there was a huge crane, one of those ancient affairs, which was simply a rotating column with a jib. I think it was built to lift up to 80 tons, and the engine and boiler were mounted right on the platform. This crane was said to have been designed by a well-known mechanical engineer and was erected by an old machinist (called fitter there), who had his own idea about crane design, and thought this particular one all wrong, and didn't forget to say so. This had caused some bitter feeling.

Just before I left it was decided to move this crane to another part of the works and equip it with electric motors. Well, the repair gang started to take it to pieces, but the first bolt they attempted to drive out wouldn't move; they tried to persuade it with a sledge, but it was no go. A bigger sledge backed by a bigger man was the next trial, and that broke the casting. Then the secret of over sixty years was revealed: Every joint, all the spaces between the castings, and even the bolts, had been covered or filled with a mixture of sal-ammoniac and iron borings, which formed the well-known "rust joint," and it had rusted up so solidly that the crane was to all practical purposes a single casting. It had to be taken apart by the aid of dynamite and a heavy tup.

EXPERIENCE.

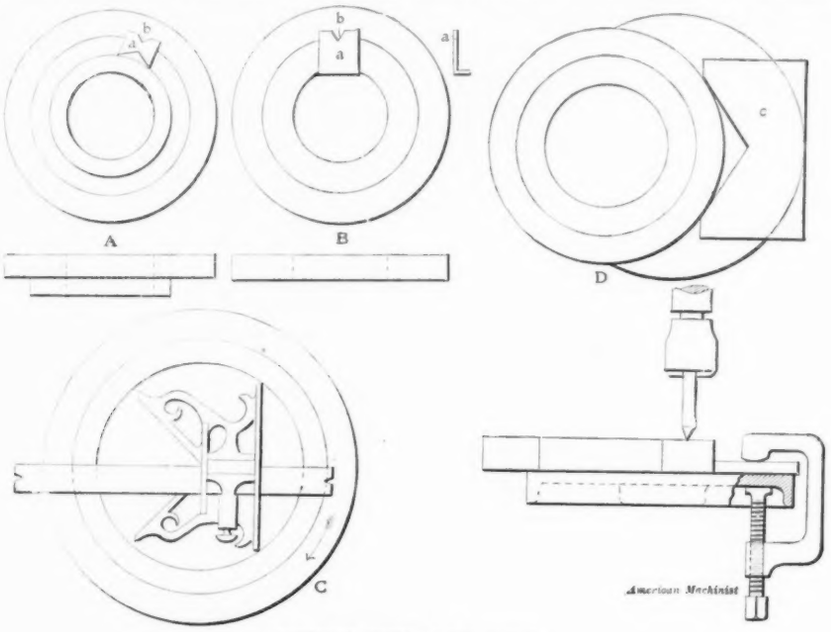
[The title of the above letter, except the interrogation mark, was made by our correspondent. We cannot think that the presumption against the old workman is warranted by the evidence. The rust joint was quite commonly used in the days when the crane was built, and we have our correspondent's own assurance that it

helped to solidify the job, and we prefer to assume that it was used entirely with good intent.—Ed.]

Scribing Circles on Rings.

Editor American Machinist:

Recently I had occasion to find an easy method of laying out circles on rings, a number of which were given to me of various dimensions, the bores ranging from 2 to 4 inches in diameter, and some of the rings being plain, some having a shoulder and some a recess. The average machinist will find a piece of wood, fit it in the ring, find the center and describe the circle, and had those rings been of one size I would have done likewise, but in this case I was compelled to find something better. A universal chuck and lathe were not on hand; so for rings *A* and *B* I took pieces of sheet metal *a*, filed notches as shown, and with a scriber in notch *b* made the circles, starting with the ring whose line was the greatest distance from the guiding edge and then filing the notch a trifle deeper to suit the next circle, and so on. On large rings a combination square can be used as shown at *C*. At *D* is shown how the same thing can be accomplished on a drill press, where a piece *c* is strapped on the table, the ring held in the V, and the table swung around until the point of the center or scriber strikes where the circle should be. The table is then held and the ring turned while held against piece *c*. D. W.



SCRIBING CIRCLES ON RINGS.

Milling Attachments for an Amateur's Lathe.

Editor American Machinist:

I was much interested in the article by Robt. G. Griswold at page 1026, relative to some attachments for the lathe. I was interested first because of the apparent usefulness of the attachments described, and second because the article was written from an amateur's standpoint. I am situated somewhat as Mr. Griswold is, but lately I have built me a roomy little shop in the yard, where I can make all the racket and dirt I wish to. I also am compelled to make my lathe do other things besides turning.

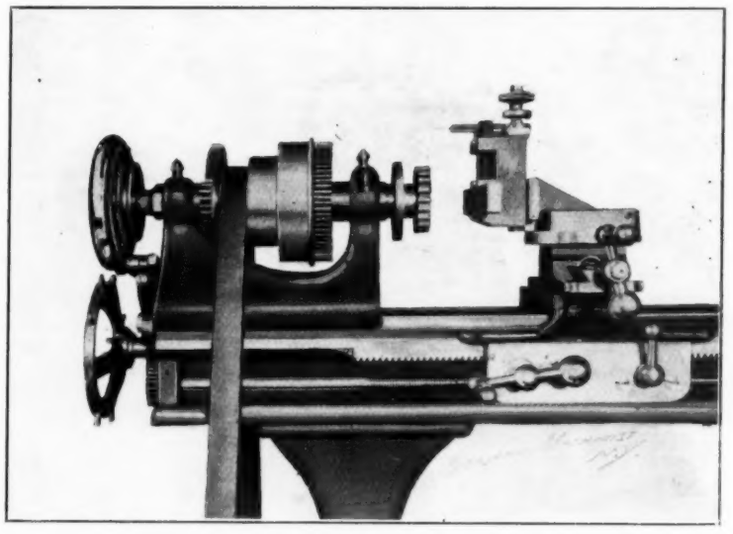
I will describe what might be called a milling attachment which I use on my lathe. The photograph shows the device fixed to the tool-post block. The base of the attachment consists of a circular gray-iron plate ½ inch thick by 4 inches diameter, with two fixed jaws of machinery steel ⅝x⅝ inch in cross-section. On this plate is mounted an L-shaped casting with oblique stiffening ribs which slips in between the jaws. A large flat-head screw passing thru the center of the casting and the plate secures it to the tool-post block. I might also mention that the plate is fitted with two steel dowel pins so arranged that the jaws may be placed either at right angles to or in line with the lathe bed, and with the screw tightened it is thus held rigidly in either position.

Vertically affixed to the casting is the traverse motion of an old slide-rest which carries two of Starrett's steel clamps fastened by screws. By the use of this slide the work may be given a rise and fall of 1¾ inches, which is ample for all my needs. To insure that the traverse motion should be accurately at right angles to the lathe bed, I fastened the *L* casting in its proper position, and then milled the face with the cutter, after which I attached the slide by means of two flat-head screws. The clamps are unusually strong for their size and will hold work up to 2 inches in diameter. The first job I did with this little attachment was to mill four sides of a piece of machinery steel ½x1x6 inches in length. The work went thru without any chatter and produced a very creditable job. To increase the usefulness of my attachment I have ordered from the lathe makers a longer cross-slide which will give a feed of some 8 or 9 inches.

When it is desired to square the ends of round or bar stock, the attachment is turned at a right angle, which brings the dowel pins into relation with two more holes, thus securing its position at the proper angle with the cutter. The attachment may of course also be swung around at any oblique angle for work that may require it.

The cutter shown is a Brown & Sharpe side milling cutter 2½ inches diameter by ½ inch face. I mounted the cutter on a small face-plate 3 inches in diameter with a 1½-inch hub. After having threaded the face-plate for the nose of the spindle, I turned down the hub, forced the cutter on and keyed it. I find it gives more satisfaction when mounted in this manner, as it runs very firm and true.

On the rear end of the spindle will be seen a hand-wheel taken from a sewing machine. It comes in handy for stopping and starting, and particularly when it is desired to turn the spindle by hand Di-



MILLING ATTACHMENT FOR AN AMATEUR'S LATHE.

rectly under this wheel is seen another wheel on a sleeve geared to the feed-screw with spokes, much the same as a pilot-wheel. I use this as a hand feed when milling, as I can thus get much finer feed than from the rack. Both wheels have keyways and are slipped on and off the same as the change gears.

Like all other amateurs I take the best of care of my tools. I have them well insured and I keep a stock book in which every tool is entered, giving a complete description, such as date of purchase, maker's name, cost, and any other information that might be a help in adjusting a loss. I keep a copy of this book in the shop, and the original in the house.

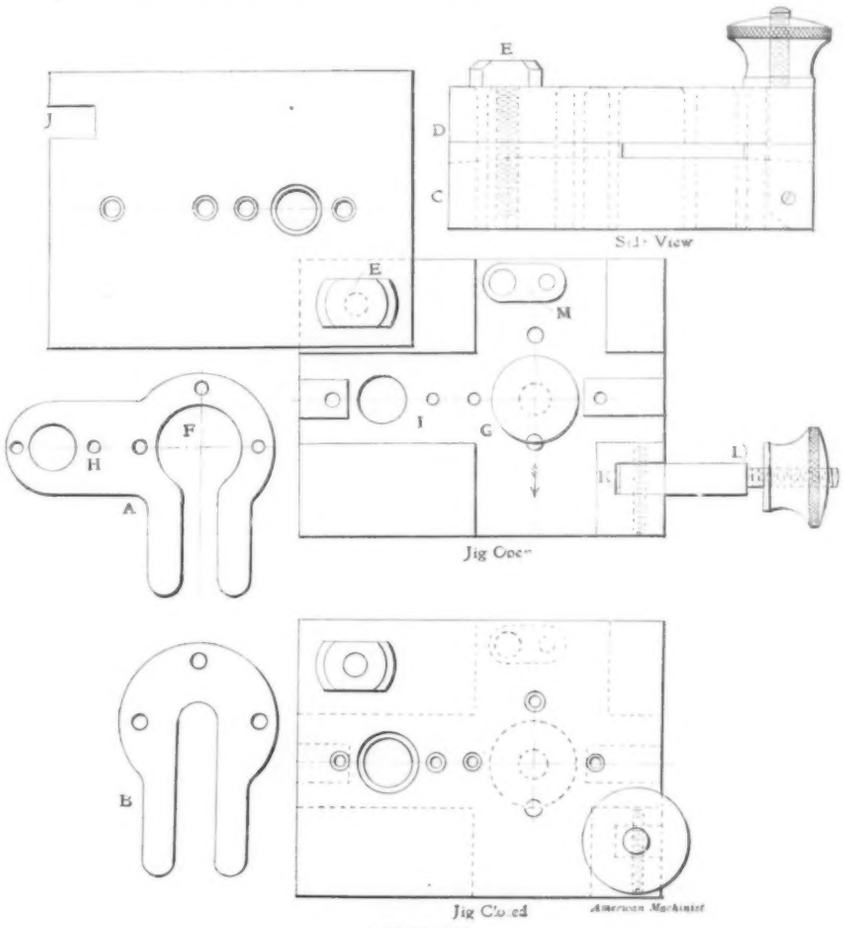
E. E. POMEROY.

A Drill Jig.

Editor American Machinist:

The drawing represents a jig used for drilling the pieces *A* and *B*, which are blanked out of 1-16 inch stock. This jig is made in two parts *C* and *D*, which swing on screw *E*. In the view showing the jig opened it will be seen that the base is grooved out to receive the work, the depth of the seat thus formed being such that when the piece is dropped in it will come slightly below the surface. In drilling piece *A* the hole *F* fits over plug *G* and the part *H* extends out thru groove *I*, the two prongs taking the direction of the arrow. When the piece is in position, the cover *D* is swung back in place, so that the slots *J* and *K* are flush; screw *L* is swung up and the two parts are held tight by the nurled nut. The cover is hardened, no drill bushings being used. The lips of the drill holes are countersunk a little to allow the oil to get down. In drilling piece *B* plug *G* is taken out and plug *M* put in its place. This plug lies in the direction of the arrow and is held central by the small pin shown. In drilling *B* only three holes are made, but these are required to come exactly in line with the corresponding holes *M* in piece *A*.

PATRICK J. KING.



A DRILL JIG.

Tooth Brush vs. Stencil Brush.

Editor American Machinist:

I have read with much interest A. S. Worcester's account, at page 1170, of how he produced his spatter work earth sections. That he did a good job is evidenced by the illustrations submitted.

As Mr. Worcester states, the ordinary method is slow, and it is also tedious for the draftsman, tho just suited to some, and therefore is expensive. Undoubtedly Mr. Worcester's method is an improvement.

There are required for his process, however, a piece of transparent paper, a pencil, a pair of scissors, some weights, a quill, a tooth-brush and a stick, besides the work of making the outline pencil tracing, cutting out the templet and placing it accurately in position.

About sixteen years ago I was employed in the drafting room of a certain engineering firm of national prominence. One important detail in finishing a tracing there, was to hunt up a nice, thin, sheet-brass stencil plate, provided for the purpose, and with a small stencil brush dipped in drawing ink print on the tracing the following immortal inscription: "Do not scale this drawing. Work strictly to dimensions given."

Once while using the stencil a fellow worker intentionally gave my elbow a shove, causing the brush to go over the edge of the stencil, making a dandy smear. That bit of a daub changed the practise regarding the making of earth sections on tracings in that office and in other establishments where I have since been employed, for when the stencil was removed there was revealed, not only a most satisfactory representation of earth sections, but also the way to do it.

All that are needed in the way of implements are a good, stubby stencil brush, small enough to go into the ink bottle and a sheet of paper from anywhere; an old envelope will do. The paper is simply placed on the tracing so as to protect the work and expose the surface to be sectioned, and is held in position by hand and moved along if the work to be done is of greater length than the paper. If there are corners to be filled in, take another piece of paper and make the corner between the two; then daub away to your heart's content. You can't hurt the tracing, and everything goes lovely, unless the brush is too wet; but anyone would know better than to start with it that way, for the job is not a barn painter's.

The best way to prepare the brush is to slightly dampen it with water and then dip it in the drawing ink just enough to cover the points of the bristles, then make a few swipes on your piece of paper (or your coat sleeve, if you prefer) until the brush is found to be just right. A little experimenting will enable anyone to tell when it is in proper condition. It is best to do the stippling lightly, as the result looks better.

This method can't be said to be new at this writing, but, as I have never seen it described in your columns, I send it along as a contribution to the never-ending supply of suggestions on how to do things in a drafting room; and it will probably meet the fate of most of such suggestions; some draftsmen will like it, others won't even try it, and probably it will bob up again a year or two hence as a new thing when somebody else has discovered it.

I think Mr. Worcester's felt sandwich for heavy lines is a good kink, for it often hustles a draftsman to get to the end of a long line before the ink gives out and he is obliged to fill the pen again.

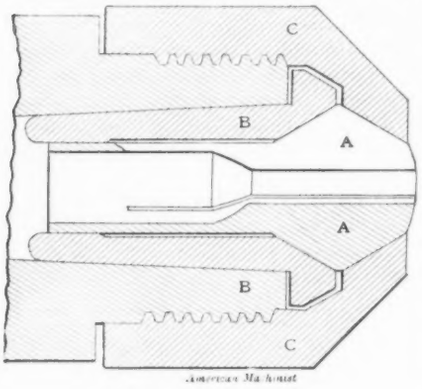
Easton, Pa. C. L. CARMAN.

A Simple Rod Chuck.

Editor American Machinist:

The drawing shows a chuck designed by me for use on lathes where it is impossible to use a draw-in chuck. It is for holding Stubs wire, Bessemer rod or cold-drawn stock of determined sizes. It is composed of three parts: the chuck *A*, bushing *B* and sleeve *C*.

The chuck *A*, one for each size of rod,



A SIMPLE ROD CHUCK.

should be made of tool steel bored to the size of the rod to be held and at the rear end considerably larger, both as relief and to give the necessary spring. This is sawed in three places to within about an inch of the rear. The size is stamped on the face, and the chuck is then hardened and drawn, the rear end to a deep blue and the front to a light straw, and more accurate results may be obtained if the taper faces are ground.

The bushing *B*, only one being required, should be of tool steel, turned a good fit to the taper hole in the lathe spindle, the parallel hole in it relieved as shown, so that the chucks will bear only at the rear and on the bevel face in front. The rear end should be rounded so that the knock-out rod will not damage it. When hardened and drawn to a light straw it should be ground to give a true seat for the chuck.

The sleeve *C* may be of gray iron or machinery or tool steel; but the latter, when the piece is hardened, drawn to a blue and ground on the chuck seat, will give the best results. It should have two or three holes drilled in the outside for a rod or spanner wrench, and should also be nurled to give a good grip when tightening by hand. This chuck, if well made, is accurate within .001 inch, and will take stock .010 inch on either side of its normal size, but over .002 or .003 inch of difference is abuse and liable to throw it out of true. LACROSER.

Hardened Rollers on Hardened Pins.

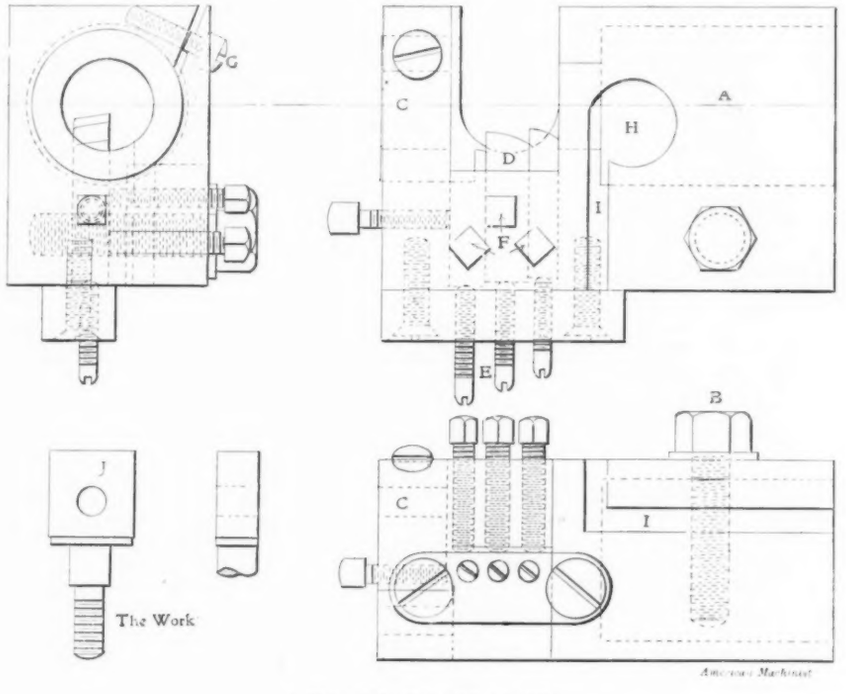
Editor American Machinist:

At page 1178 Mr. G. Schneider tells of his experience with hardened pins. We have some twenty-four machines with three dozen rollers on each. These run at very high speed on the periferies of cams. We have used hardened pins and soft rollers, with the result that we would have flat places on the rollers. Then with hardened rollers and soft pins we would have flat places on the pins. Under the most favorable conditions they lasted about two months. For the past two years, however, I have been using hard rollers and hard pins, with the most satisfactory results, having no need of replacing the same, and only one case of abrasion. These rollers are 2 inches diameter, 1-inch face, ¾-inch hole. The pins are allowed .002 inch slack, insuring good lubrication under a constant pressure of about 100 pounds. E. WAGNER.

A Box Tool for the Lathe.

Editor American Machinist:

The drawing shows a box tool made by one of the toolmakers in our shop, to be used on a lathe. Not having any screw machine, the screw shown in the sketch had been made outside, until this toolmaker, having charge of the shop, figured out that with a few lathe attachments he could have such screws made in the shop cheaper than he could buy them. The body of the box tool is bored out at *A* to fit the tailstock spindle, and is bound by the screw *B*. *C* is the hardened bushing



A BOX TOOL FOR THE LATHE.

thru which the stock enters. The cutting tools *D* are adjusted by screws *E* and held by set-screws *F*. *G* is a binding screw, by which the different bushings are held. The hole *H* and slot *I* allow screw *B* to clamp the affair in place. This tool proved so successful that several other jobs previously done outside were made with it. We used for a lubricator a piece of pipe with a cap on one end and having a small piece of pipe extending with a little faucet. To the cap was attached a forked piece which extended under cap screw *B* and held this drip cup over the work. The flat part *J* on the work was of course milled in another operation. PATRICK J. KING.

That "Interesting Shaper Job."

Editor American Machinist:

I was very much interested in the article by C. P. Lipphart at page 1175, showing the method of planing shaper frames at the Steptoe shops. While the description given is quite clear, I do not see how it is possible, especially on the long strokes and using the method shown for supporting the job, to eliminate the tendency to spring sufficiently to plane a very accurate surface and one that will be square with the column. Mr. Lipphart's statement that 90 per cent. of the time formerly required to do this work on the planer is saved by using the shaper seems remarkable, in view of the fact that planer manufacturers are claiming 125 to 150 feet and even more cutting speed per minute. This naturally prompts the query as to how long it took to do the six frames on the planer, and whether that time could not be reduced by employing some different method of setting or handling the work. Perhaps Mr. Lipphart will give us the actual time in minutes for both the planer and shaper, which may serve as "food for thought."

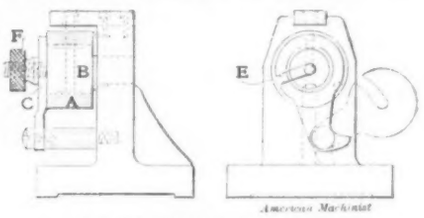
C. E. HOLGATE.

[In a job of this character cutting speed is comparatively unimportant and the method described by Mr. Lipphart, we understand, saves time only in setting and resetting the work for the different operations.—Ed.]

Jig for Drilling Collars.

Editor American Machinist:

The illustration shows a simple drill jig adapted for conveniently drilling collars or any work of a similar character. The collar *A* is held in position on plug *B* and clamped by the swinging clamp *C* against the three hardened pins *E*. The



JIG FOR DRILLING COLLARS.

motion of the swinging clamp is limited by the center stud and the pawl on the end of the clamp. The thumb-screw *F* is smaller than the bore of the collar, thereby allowing the collar to pass over without the removal of the thumb-screw.

BARNETT.

Turning Slim Taper Pins—Arbor for Shell End Mills.

Editor American Machinist:

The brass pin shown in Fig. 1 is 3-16 inch in diameter at the large end, ½ inch threaded and ½ inch plain. The taper part is 4 inches long and the diameter at the small end is 1-32 inch. To turn the taper, which is done at a single cut, we use the guide here shown. The pins are first threaded and then cut off to the length from straight stock, this being done in a turret lathe. To turn the taper part the threaded end is screwed into a chuck in the live spindle of a lathe which has a taper attachment. The guide, which has a 3-16 inch hole thru it and is cut out at the side as shown and hardened at this end, is fitted to the tailstock spindle. The tailstock is clamped in proper position and the spindle screw is taken out so that the spindle will be free to travel back and forth. The pin to be tapered being screwed into the chuck the guide is advanced until the projecting end of the pin just comes to the shoulder *B*. A tool is then adjusted to turn to the smaller diameter of the taper, 1-32 inch, and the tool then advances pushing the guide forward with it, the taper attachment gradually withdrawing the tool and producing the taper required. With this arrangement a boy can comfortably turn 30 pins an hour.

Fig. 2 shows an arbor for shell end mills as used on Brown & Sharpe milling machines. As all who have used these know, it is necessary to have arbors both right and left hand to suit right- and left-hand milling tools. The arbor here shown enables the user to drive either right- or left-hand mills, the difference being that instead of the driving collar being threaded it has a square hole machined in it with a square on the arbor to fit it. Y. K.

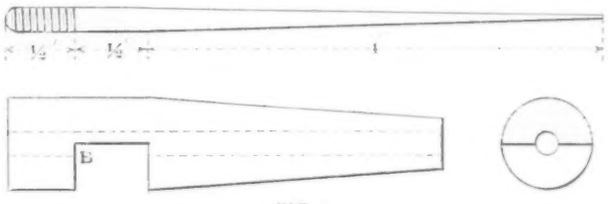


FIG. 1

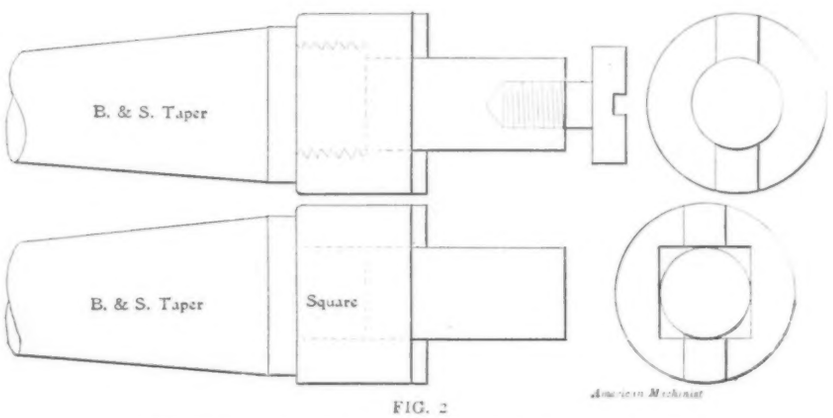


FIG. 2

TURNING SLIM TAPER PINS—ARBOR FOR SHELL END MILLS.

A Wedge for a Hammer Handle.

Editor American Machinist:

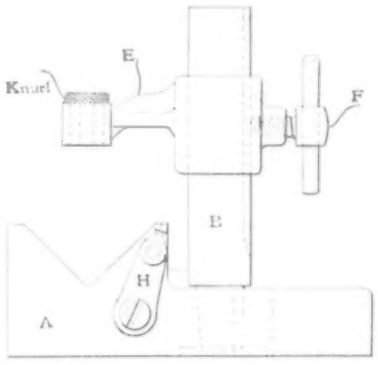
Some time ago I had occasion to put a handle in a hand hammer, and as I looked over the bench for something to file a wedge out of, an old machinist said, "Let me show you how to make a wedge quickly that will never jar out and will hold your hammer head on."

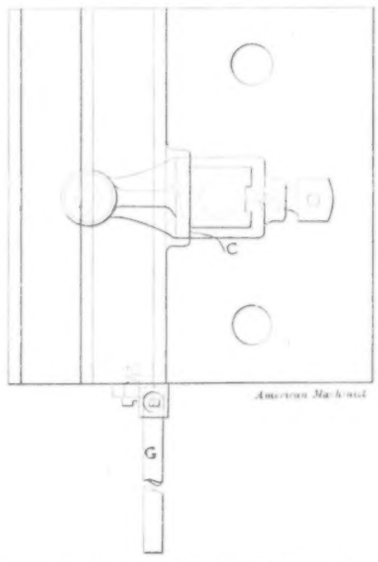
He took a sheet-iron washer about 1-16 inch thick, ⅞ inch outside diameter and ¼-inch hole, filed it sharp on about half its outside edge. He then drove it into the end of the handle edgewise, leaving enough out to file to the shape of the handle. If it is driven tight enough, the wood will swell into the hole in the washer and hold it tighter than any taper wedge can be. This system has given perfect satisfaction on several hammers of different styles. APPRENTICE.

V-Block Fitted as an Adjustable Drill Jig.

Editor American Machinist:

The accompanying sketch shows a V-block fitted up as an adjustable drill jig, for drilling holes central in various sizes of round stock. The square spindle *B* is turned tapering at one end, and driven in block *A*, thru which it extends into a





V-BLOCK FITTED AS AN ADJUSTABLE DRILL JIG.

counterbored hole, admitting of easy removal (with the aid of lead hammer) so that the V-block may be used for other purposes. One side of this spindle comes in contact with a lug *C*, thereby locating the drill arm *E*, in which various size slip bushings are used, central with the V in the block.

The spindle *B* has a groove cut lengthwise on one side, forming a seat for the point of screw *F*. The arm *H*, clamped by a filister head screw when swiveled to the left in connection with the rod as shown and held by a set-screw, acts as a gage when drilling work a certain distance from the end. The gage rod *G* is long enough to reach the center of the bushing.

BARNETT.

Gages for Textile Machine Work.

Editor American Machinist:

The accompanying sketches show the gages used in the manufacture of spindles for textile machinery in our shop.

When a drawing is received for a new spindle, the first thing done is to make a sample, which is used as a standard for all others of that kind made. Hardened and ground plugs are made for the different diameters and tapers and are used to make the gages from and for testing the gages.

For grinding straight work over 4 inches in length ordinary yes-and-no ring gages are used. The operator also has a try gage, like Fig. 1, made from ¼-inch stock, thickened to ⅜ inch at the contact points. The operator uses this gage without removing the work from the machine. When this gage will go over the work easily the operator removes the work from the machine and tries his yes-and-no gages, which have a limit of .0015 inch, and he rarely has to put the work back in the machine. As the gage wears it is peened at B to bring it back to size.

For straight work under 4 inches in length a yes-and-no snap gage like Fig. 2 is used. The adjustment for wear is made by driving the taper pins *A A* in a little farther. This gage is made from ¼-inch flat stock.

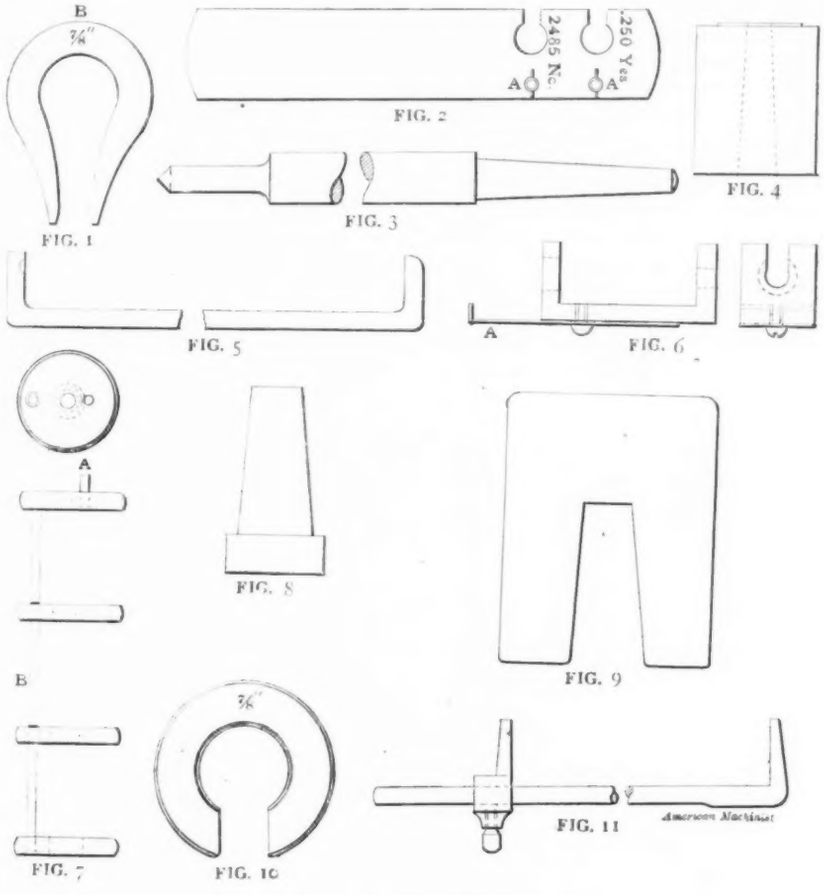
Fig. 3 is a spindle on which the taper has to be ground very accurately, and the gage has to be a certain distance from the extreme point within a limit of .01 inch. Three gages are used, Figs. 4, 5 and 6. Fig. 4 is the ring gage to get the taper by, and has a step on top .01 inch high. Fig. 5 is the spanner gage to get the length by, made from ½-inch square stock. Fig. 6 is the try gage. The slot is cut in the top so that it will slip over the center, so as not to back the center off when trying the gage. When the operator rigs up the machine for grinding this taper, he first grinds one spindle to size and then adjusts the little piece of steel *A* so that it will just rub against the side of the rest. This gage will then show every time when the work is down to size. In grinding each piece he uses this gage, and when he feels it touch the rest he removes the work and tries his ring gage and then his spanner, which has to touch on the lower step but not on the top one; anything between the two is all right.

The gage, Fig. 7, is the one used for gaging our taper grinding up to ⅝ inch diameter and 6 inches long. When taper and size are correct the end of the spindle will come flush with the top of wire *A*, the top ring will be flush with the wire *B* and the two middle rings will be flush with the marks on wire *B*. For small, accurate taper work this gage can be recommended as the best thing I have ever seen. As the gage wears, the wire *A* can be driven out and a longer one inserted, and if the holes do not wear equally, the ones that have worn least can be polished out. All of our gages for lathe work up to ½ inch are made like Fig. 2, but with only one hole, the roughing gages being made with point contact and the finishing with line contact, as shown.

For gaging taper work, like Fig. 8, on the turret lathe we use a gage like Fig. 9, and the taper is determined by placing the gage on the work and holding up to the light; the size is determined by the gage touching both the taper and the shoulder on work. On lathe work above ½ inch we use the gage Fig. 10, made from 3-16 inch flat stock. For pointing to length we use an adjustable spanner gage like Fig. 11, made from round stock.

These gages are all easily and cheaply made and fulfill all of the requirements of spindle-making, and will perhaps be of use to others.

PAUL WESLEY.



GAGES FOR TEXTILE MACHINE WORK.

Forms for Planing.

Editor American Machinist:

The boss came to me one day as he returned from a rival shop, and said, "Why don't you make forms for your planer work? Mr. So-and-so claims the success of his business is due to using them." I replied that I had forms for most of the work and that I would get out others for any job they could be used to advantage on. The shop he spoke of I knew used the forms to finish the work to size with, using no templet or standard gages. The idea was to have the forms behind the work, and, after the roughing had been done, to just touch the finishing tools to the different parts of the form, and the work must be just like the form. That was what my boss wanted—to use no templets or gages and do away with the fitting of gages.

Now, when it comes to close work, anyone that's been there knows that you can't set the tool to cut twice alike in the above manner. And my boss readily understood it when I had explained that So-and-so's method might do for them, but that when I made a fit, I wanted to feel it, as I knew of no other way that was as sure.

When setting a tool to a form, unless you feel it with paper, there is no way of knowing just how hard you touch the form; and were the form even made under size to allow for the thickness of the paper used, there would be no telling how much the tool might spring off or how clean it would cut, and were the casting a little hard or the tool less keen one time than another, the job would be larger and of different sizes. I may add here that some shop men think the work is made standard solely to repair any broken parts wanted later. My idea is that it's made so principally that time may be saved in the *building* of the machinery. Forms or dummies save a great amount of time and guessing and are fine to work with on the

planer, but when it comes to standard work, a positive gage is required.

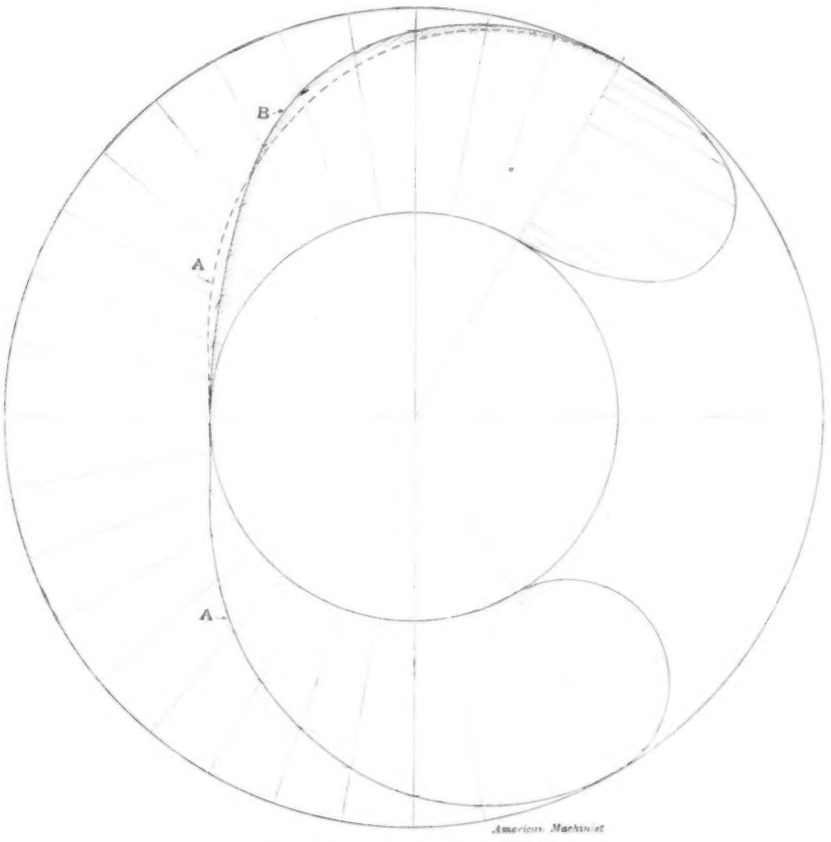
For fitting dovetail work there is nothing I know of better than a gage made to use a taper wedge with; the wedge, if made 5-16 inch taper per foot, will show about 3-64 off when there is a difference of but 0.001 inch. The wedge of course has a line to show when it's in to a standard fit, and this line may be removed and a new one made when there is any wear noticed. H. L. CAMERON.

Improving a Cam.

Editor American Machinist:

I was interested in E. W. Lawrence's reference, at page 1176, to a cam cutting rig. I remember being employed by a printing press manufacturing company and having a lively time with a fly cam. This is the cam which, in conjunction with a spring of some length, operates the fly, delivering the sheet after it is printed. This cam seemed to have the same objectionable feature as with some of the cams in other makes of presses, but somewhat more pronounced. Slap, bang; slap, bang; it seemed as if the fly would pound itself to pieces on the rest rod and also when delivering the sheet. Something had to be done. Evidently, it was thought, the movement could not have been developed to embody the crank functions of acceleration and retardation, yet on reference to the drawings it was found that it had been, so it seemed that the plan of cut and try with a hardwood pattern until a smooth working form was developed was the only solution. This is a style of cam development frequently in use, as many of your readers no doubt know. It has its demerits as well as its merits, for many valuable movements have developed out of wood whittling.

It occurred to me, nevertheless, that some form other than a semi-circle, divided into a number of equal parts and ordinated, could be substituted to give the desired effect. After some consideration the ellipse presented itself to my mind as giving a slower approach to the terminals than that of the crank, altho moving quicker in the central position, which in this case did not matter much. A development on these lines was made and gave excellent results. I have used it also on other cam formations and it has been equally satisfactory.



LAYOUT OF A SMOOTH WORKING CAM.

In my many years of practise I have not met with any work on cam development using this elliptic method, and as I found it a valuable and direct way of developing a desired motion I felt it might be of interest and possibly valuable also to many of your readers. I send you drawing of both layouts, namely, crank and ellipse, and place the developments one over the other that the difference may be seen. Line *A* is laid out from the circle and *B* from the ellipse. VETERAN.

Sunlight Wins?

Editor American Machinist:

The article at page 602 reminds me of a little yarn told me by a steel salesman once. This man had served his apprenticeship as a blacksmith and then had worked in all the departments of one of the Pittsburg steel works, eventually graduating as a salesman. His thorough training in the making and working of steel, coupled with his undoubted ability to sell, made him a very valuable man to his employers. One day from somewhere out in the country he received an order for some steel for a special purpose. The steel was duly shipped, and a few days later a complaint came in that the steel was absolutely worthless—that it was impossible to temper it without cracking. He wrote and gave minute directions for tempering the pieces. A day or two later a very angry man appeared at the store and asked to see Mr. Mac.

"Mr. Mac, that d——d steel you sold me must be made out of sash-weight iron; it's no good. The pieces cost $28 each to machine, and then when we temper them they fly all to pieces."

"Well," said Mac, "what are the shop conditions? What appliances have you?"

"Everything of the very best; no expense has been spared; shop brand new. Oh, you can't say our appliances aint right; it's the poor steel you've sold us."

"Oh," said Mac, "you mean the machine shop. I suppose you have a dirty black hole of a forge shop, where a man can't see what he's doing."

"Nothing of the sort," retorted the customer; "it's as light as day; fine big windows all around—the best light in the shop."

"Just what I thought," said Mac. "Paint those nice big windows black, and give your smith a chance to see his heat, and the steel won't be ruined as this piece is, by overheating."

This is a case where sunlight did not win. DIXIE.

A Warning.

Editor American Machinist:

You will remember that three or four years ago we reported to you that some person was traveling about the States claiming to be sometimes the son of Charles Churchill, sometimes of Lord Armstrong, and various other names on this side. We have not heard anything on this matter for the last two years until just now another of our manufacturing friends in the New England States near Boston writes that they had a call on July 15 from a man representing himself as my son and as the manager of our Birmingham branch, and that he wanted to borrow money enough to get back to New York. This friend was good enough to respond to his needs, but we should esteem it a favor if you would insert a little notice in your journal, stating that this vagabond is still traveling the country and claiming to be connected with our house and other engineering houses on this side.

CHARLES CHURCHILL & CO., LTD.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

World Building, New York.

Also Published at 6 Bouverie Street, London, E. C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, World Bldg., New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by all newsdealers generally.

The AMERICAN MACHINIST Co., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 25 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *27,100 copies are printed. Total for 1904, so far, 820,250. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

Contents.

	PAGE
Compressed Air Power Transmission Plant of the Cleveland Stone Company	1317
Japs Are Silent Bridge Builders	1320
General Features of German Education	1320
Legal Notes	1322
An Old Engine	1322
Foundry Practise with Copper and Its Alloys	1325
A New Premium Plan	1325
Electric Driving at the Witton Works of the General Electric Company.	1326
The Machine Shop and the Home	1327
Slotting Friction-Draft-Gear Cylinders—Milling Air-Pump Cylinders—A Special Milling Machine.	1328
Mechanically Made Cores—A Practical Core Machine	1330
A Large Horizontal Boring, Drilling and Milling Machine	1332
Echoes from the Oil Country—The Young Machinist as a Salesman.	1332
Letters from Practical Men	1334-1349
One Cause of Difficulty	1350
International Standard Testing Methods	1350
Technical Publications	1351
The Launch of the "Connecticut"	1351
Gift to Syracuse University	1351
Some New Things	1352
Incandescent Gas Mantles by Automatic Machinery	1354
Foreign Markets for American Machinery	1355
Personal	1355

One Cause of Difficulty.

Some manufacturing concerns might be considerably surprised if they were to look over the correspondence that reaches this office from employees who, for one reason or another, are dissatisfied or distressed at the treatment they receive. Many of the complaints have little basis; some of them are merely querulous and made by men who would evidently never be satisfied in any event. Others are well founded if the facts are just as they are stated to be; but we cannot be sure of that, and have neither the time nor the opportunity to sift the matter and find out about it. We of course know that there are always two sides to a story. But some of the stories bear internal evidence of accuracy and are supported by other and independent information.

Some of these complaints tell of doings that would scarcely be thought possible. For instance, one of the latest is to the effect that a certain machinist working in a certain prominent shop, being offered higher wages elsewhere, quit and asked for his wages earned. The superintendent abused him, using "obscene language" in doing so, and the workman, now in another city, has so far been unable to collect the wages due him, the excuse he says they give being that, unless he comes in person for his money or sends a written order for someone else to get it for him, he could collect it twice. In other words, they refuse to remit the amount they owe in the usual way (by check or otherwise) obviously with the intention of making him as much trouble as possible.

Of course, a business man finding himself in such a difficulty would have an easy way out of it. He would simply put the case in the hands of a lawyer, who would easily collect the money; but workmen do not like to do that, or they do not know what their legal rights are. Perhaps they ought to call in the assistance of lawyers in such cases oftener than they do, but as it is they usually "take it out" in giving the firm as bad a reputation as possible among their fellow-workmen, and we know it to be a fact that some of the firms who complain of the difficulty of getting and keeping good men owe their troubles largely to this fact.

When a superintendent or a manufacturing firm treats a workman in this way—a way in which they would not for a single moment think of treating another business concern—one from whom they might be buying supplies, for instance—they are not only laying up trouble for themselves in all their dealings with workmen, but they are at the same time making trouble for other manufacturers; because such actions strengthen the hands of those whose constant object it is to make workmen believe there are few, if any, employers who will do the fair thing and treat employees "white" unless compelled to do so. Much of the bitterness of the present situation is due to such things done by comparatively few employers, who seem to forget that there is such a thing as a moral law and that it does not pay to violate it.

Business men have their commercial agencies and reports, besides other means of finding out what the reputation and standing of other concerns are. Workmen do it by a different method, but it is just as effective, and the superintendent or employer who thinks he can treat men unfairly in such matters and not suffer for it makes a great mistake. The reputation of a shop for being "white" or otherwise spreads far and wide, and good men usually know pretty accurately whether it is a good place to work in or otherwise. This often means much to the establishment concerned, especially when good men are scarce.

International Standard Testing Methods.

A few weeks ago (at pages 974 and 1141) we published comments upon the work of the American Society for Testing Materials and expressed our regret that this society had been unable to co-operate with the International Society in the establishment of an international standard method of testing, which would have made the results of tests, wherever or by whomsoever made, strictly comparable. This is aside from the fact that there is a very great probability that tests made by methods approved by such an international society would be much more strictly scientific and much more to be depended upon than are the tests now generally made here and, according to Professor Unwin, in England as well. The *Engineering Magazine*, referring to this matter, says:

"We have already referred to the manner in which the American Society for Testing Materials appears to have neglected the principal object for which the parent International Society for Testing Materials was formed, and this is a matter to which the attention of the engineering profession may well be directed. The original idea of forming such a society was that of unifying the methods of testing materials and of recording such tests to an extent which would enable the valuable work being done in all parts of the world to be strictly comparable. In addition to the accomplishment of this most desirable object, the International Society has taken up the questions connected with the conduct of such tests, studying the methods which give the most reliable results, and standardizing the practise of its members all over the world. In this most important undertaking the work of the Continental engineers has been extremely valuable, and it is most unfortunate that the American members have seen fit to neglect such associated international efforts. Since its formation the American society has practically become an organization for the discussion of materials of construction in a most general manner—a work entirely within the scope of the existing national

societies with which most of the members are already affiliated, and for the conduct of which no new organization was needed.

"Meanwhile the subject of the unification of methods of testing, for the furtherance of which the society was originally formed, has been almost entirely neglected, and any attempt to harmonize American practise with that of other countries has apparently been dropped. Various reasons have been advanced for this curious conduct, but it is unnecessary to discuss them in this place. The result cannot but be injurious to the scientific development of American engineering, and ultimately to American commerce in engineering products in other parts of the world, and it should be the duty of all American engineers who have the real welfare of the profession at heart to bend their efforts to the correction of what, to put it in the mildest possible manner, has shown itself to be a distinct blunder."

Very few engineers are interested in testing materials who are not also interested in the whole broad subject of the materials of engineering, and most of them are also interested in the manipulation of those materials. These are just the matters dealt with in the various older engineering societies, such as those of the civil, mining, mechanical and electrical engineers, and it seems to be obvious that the testing of materials alone is too narrow a basis upon which to found an engineering society. This is clearly shown by the fact that the society referred to goes outside that subject in its meetings, and in doing so covers ground already covered by older and in every way well conducted societies. The original object of the formation of the American society—*i. e.*, to promote the adoption of a world-wide uniform method of testing—was in every way commendable. It has been abandoned by the American society and a reason for this which has been asserted is that the American section is so strongly dominated by strictly commercial considerations as to make it impossible to secure an agreement to a method that is scientific and which would hold the makers of materials strictly up to contracts and specifications. Whether this charge is true or not, we do not pretend to say, but the fact that it has been made makes it seem especially desirable that the American section should endeavor to come to an agreement with their foreign confreres. If they do not do so, then we see no escape from the conclusion that American-made machinery and American goods generally will be more or less handicapped in the coming development of foreign trade.

If the American Society for Testing Materials will not take up this matter and endeavor to come to an agreement upon it, then we think the American Society of Mechanical Engineers and the Civil Engineers' Society should do so. The matter comes well within their scope.

Proprietors of certain large industrial establishments have received letters from Secretary of the Navy Morton inquiring as to the rates of wages paid to machinists, it being understood that the information gained in this way is to be used in connection with a request for more pay made by the machinists employed in the navy yard at Washington. Washington is said to be a very expensive place in which to live. We frequently see statements showing how utterly impossible it is for Congressmen and other officials to live there under present-day conditions upon salaries fixed in earlier days when the cost of living was much less and the general standard of living much lower. In fact, it is declared that the only way some of the Representatives and Senators live at all is that they have independent incomes, which of course is not the case with machinists working at the Navy Yard. These things will, however, have little influence in deciding the rate to be paid. We mention them only as points of interest in connection with the subject.

A new record in criminal impudence seems to have been made in the report of the local Board of Steamboat Inspectors on the burning of the "General Slocum." The prominent facts of the case are known to all the world, so that there is no occasion for us to rehearse them. A thousand human lives were destroyed under conditions which were only made possible by an unparalleled co-operation of not only criminal negligence and incompetence but of willful, systematic, continuous reversal of the functions of most responsible public officials. The reports of inspections issued by the board, qualifying passenger carrying steamboats to ply in New York harbor might have been taken as guarantees of death and disaster rather than of life and safety. The public upon ample evidence holds the steamboat inspectors to be the archhomicides of the "Slocum" victims, yet they not only continue in office but pretend to investigate a disaster to which they chiefly and primarily contributed, and their report is that they are innocent of it all.

Technical Publications.

"The Polishing and Plating of Metals." By Herbert J. Hawkins. 355 5½x7½-inch pages, with 76 illustrations. Haslitt & Walker, Chicago. Price, $2.00.

It is always a pleasure to find a book upon the technicalities of a trade written by one who has acquired a first-hand acquaintance with it thru long and varied experience. The experience of the author with the work of which he treats is manifest upon every page and with scarcely a superfluous word he packs his book with information. A very useful chapter is the second one, on the effects of the acids and solutions of the plating room upon the plater's health, on the precautions necessary to avoid them and on their treatment. Special chapters are devoted to polishing and grinding, acid dips and pickles, the management of dynamos, plating with gold, silver, nickel and copper and upon other branches of the plater's art.

"Forge Practise." By J. L. Bacon. 257 5x7¼-inch pages, with 272 illustrations. John Wiley & Sons, New York. Price, $1.50.

This volume is the outgrowth of the author's work as a teacher at the Lewis Institute. As stated in the preface, "it is not the author's purpose to attempt to put forth anything which will in any way take the place of actual shop work, but rather to give some explanation which will aid in the production of work in an intelligent manner."

The exercises chosen as illustrations are simple but excellent and very comprehensive. They include welding, upsetting, drawing out, bending, steam hammer work, duplicate work and tool forging and tempering, together with chapters on the calculation of stock and on the metallurgy of iron and steel. As an elementary treatise on blacksmith's work the book is in every way admirable.

The Launch of the "Connecticut."

On September 29, at 11.17 A. M., the battleship "Connecticut" slid gracefully down the ways into her natural element. The launch was without a hitch of any kind. It was without doubt the "cleanest" job of the half hundred launches we have witnessed, both here and abroad. The only mistake of any sort was perpetrated by Miss Alice Welles, the official sponsor. Her failure to break the bottle would, to our mind, tend to show that the athletic training of young women (especially the future sponsors of ships) is imperfect.

At the last moment the young lady pitched an outshoot which missed the prow and, while the umpire called one ball, Frank Ryan, a young rigger stationed at the bow of the "Connecticut," saved the day by breaking the bottle, shouting at the same time, "You'll be christened anyhow; d—n you, you're the 'Connecticut.'"

Gift to Syracuse University.

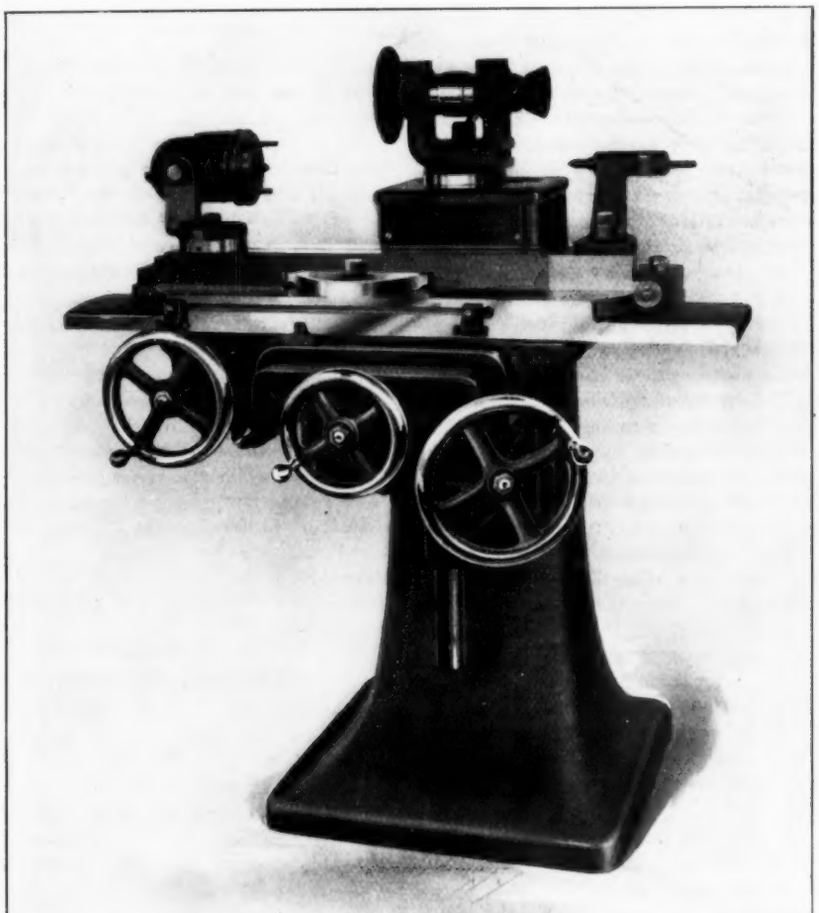
Chancellor James A. Day, of Syracuse University has announced the gift from Lyman C. Smith, of Syracuse, N. Y., of an additional building for a model factory for the Lyman Cornelius Smith College of Applied Sciences. Mr. Smith four years ago established the school, giving $750,000. The cost of the new structure is estimated at more than $100,000.

A quite unusual accident occurred at the Potter Press Works, Plainfield, N. J., a few days ago. By the catching of a belt nearly 50 feet of the main line shaft was torn from the hangers while running and fell to the floor. Fortunately no one was seriously hurt.

Some New Things.

UNIVERSAL CUTTER AND TOOL GRINDER.

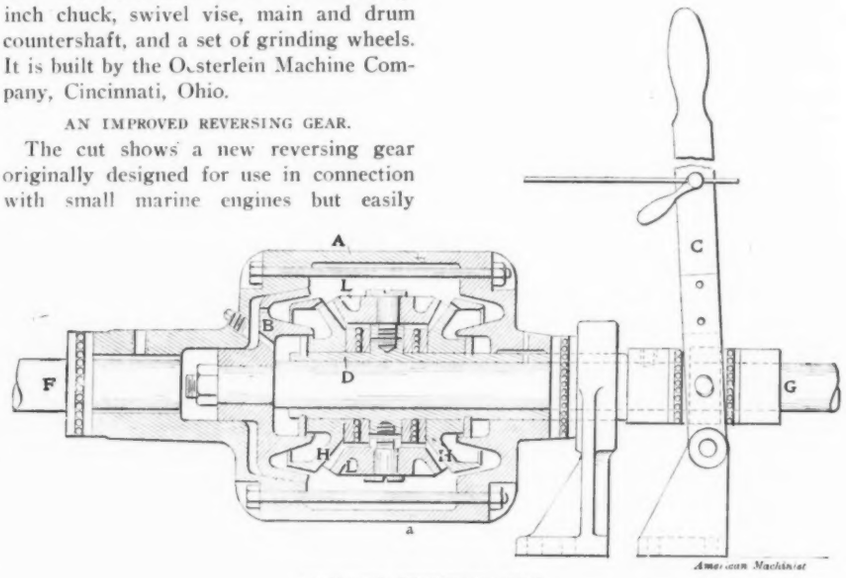
The illustration shows a newly designed universal cutter and tool grinder. The column, as well as knee, saddle, slide and table, are of box form with internal braces. The wheel spindle frame can be swiveled 180 degrees; the base is graduated and locked in any position; it is dust-proof and can be adjusted to compensate for wear. All bearings, slides and screws are covered. The adjusting hand-wheels are graduated on the outside, reading to thousandths. The table is swiveled on a central stud and clamped in any position, has graduated arc in front reading to degrees; a scale is imbedded in slide and reads to 3 inches taper per foot either way. One end of the table is formed to a worm segment into which engages a worm by means of which the table can be readily adjusted either way to the desired taper. For all operations there is but one tooth rest used; it has a micrometer adjustment and can be set in any position. Dimensions of machine are: Table movement longitudinal, 15 inches; cross movement, 8 inches; vertical movement, 7 inches; swings between centers, 9 inches, with raising blocks 12 inches by 20 inches long; grinds 16-inch face mills, 36-inch saws. Many operations can be done on this grinder for which other grinders require special attachments such as grinding gear cutters, face of teeth in taps, formed cutters, hobs, etc. With this machine is furnished a 3-inch chuck, swivel vise, main and drum countershaft, and a set of grinding wheels. It is built by the Oesterlein Machine Company, Cincinnati, Ohio.



UNIVERSAL CUTTER AND TOOL GRINDER.

AN IMPROVED REVERSING GEAR.

The cut shows a new reversing gear originally designed for use in connection with small marine engines but easily adaptable to other service. In explaining the operation of this device we may assume shaft *F* at the left to be the driving shaft and *G* the shaft which is driven. The gear case *A* is keyed to shaft *F* and turns with it. This case is made in halves which are solidly bolted together, the joint being at *a* near the middle. The driven shaft *G* has fastened to its inner end a conical friction head *B*. This shaft *G* has a certain amount of longitudinal movement, being shifted in either direction as required by the vertical lever *C* and the lever clamped in either position, as may be required. When the shaft is thrown to the left the external conical surface of *B* engages the internal conical surface of case *A* and then both shafts rotate together. To stop shaft *G* from turning, it is only necessary to move it to the right sufficiently to withdraw *B* from frictional contact with *A*. The long bronze sleeve *D* has a longitudinal movement. It extends out thru the fixed bearing *E*, this bearing having a feather which at all times prevents the sleeve *D* from turning. On this sleeve *D* are two freely turning bevel gears *H* held in place endwise of the sleeve by collars. Mounted upon opposite studs on sleeve *D* are two freely turning pinions *L*, both constantly in mesh with gears *H*. The right-hand gear *H* has an external conical surface which fits the internal conical surface of friction head *B*, while the external conical surface of right-hand gear *H* fits an internal conical surface at the right-hand end of case *A*. We have seen how shaft *G* is rotated in the same direction as shaft *F*; to cause it to turn in the opposite direction lever *C* is thrown to the right, carrying shaft *G* in the same direction. This locks *B* and the left-hand gear *H* together and the continued movement of shaft *G* in the same direction, sleeve *D* moving with it brings the right-hand gear *H* to engage with case *A*. Then, as sleeve *D* does not turn, shaft *G* is driven in the opposite direction from the rotation of case *A* and shaft *F*. It will be noticed that the forces in line with the shaft in either direction are all taken by ball bearing thrust collars.



IMPROVED REVERSING GEAR.

This device is made in various sizes by August Mietz, 128-138 Mott street, New York city.

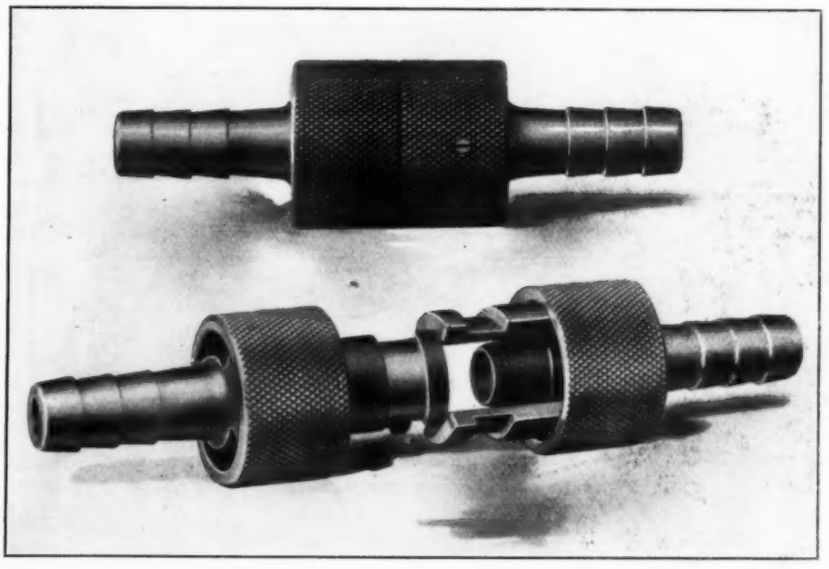
DRILL CHUCKS.

The half-tone shows a couple of scroll drill chucks, each type of which is made in two sizes, the nurled chucks taking up to 5-16 and 9-16 inch, respectively, and the key chucks having a capacity from 0 to ½ and from 1-64 to ⅝ inch. The chuck with nurled sleeve is self-tightening, after the jaws are brought into contact with the drill, and therefore needs no spanner wrench, as any resistance causes the jaws to grip the drill more tightly. This is due to the fact that the scroll is formed on the member fitted with the driving shank and the tendency of the drill when cutting is to rotate the jaws relatively to the scroll and thus set them up still harder. The inner ends of the jaws are also so beveled as to bring the edges slightly ahead of the center, this increasing their gripping capacity still further. The chuck to the left in the cut has a geared scroll, the head for the key coming flush with the body, and will hold tight when running either forward or backward. The nurled chuck is equipped, as shown, with a solid arbor with blank shank. Both chucks, it will be noticed, have long bearing surfaces for the drills or work, and the jaws are well supported, the chuck nose being extended, as indicated, almost to the outer end of the jaws. The Cushman Chuck Company, Hartford, Conn., is the manufacturer.

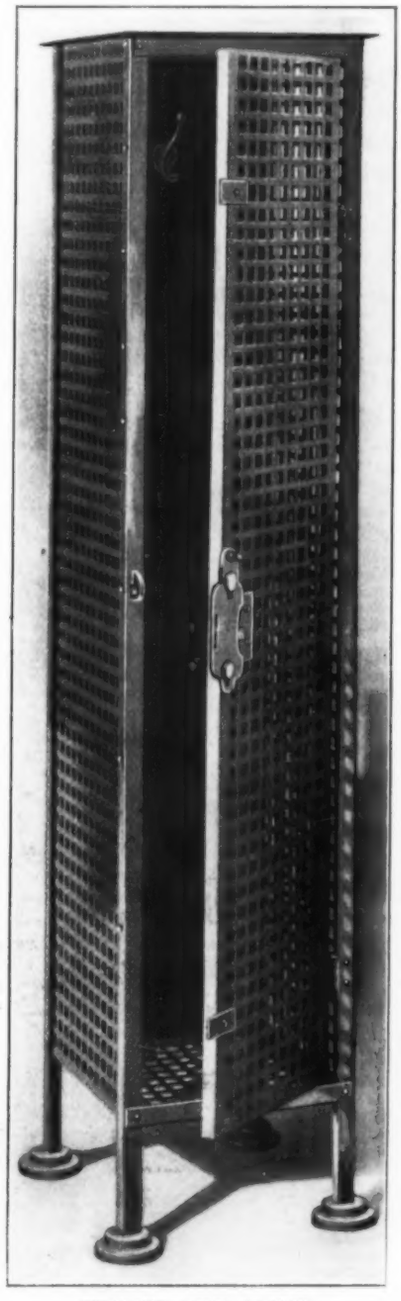
DRILL CHUCKS.

AIR HOSE COUPLING.

A new coupling known as "Giv't-a-Twist" has just been brought out for use in connection with pneumatic tools. No wrench or spanner is required to either couple or uncouple the parts. To make connection it is only necessary to push the halves together by hand and slightly twist the locking rings in opposite directions. To uncouple, the operation is reversed. Both halves of the coupling being identically the same, the necessity of mating the ends is obviated. As will be seen from the half-tone, there are no projections to catch or break off when the hose is dragged from place to place. The rubber sleeve is entirely encased when the coupling is made, and will withstand any working pressure without leakage. The parts are made of brass, and to stand rough usage, and are machined throughout. The coupling is manufactured in all standard sizes for connecting hose to hose, hose to pipe or pipe to pipe with male or female shanks, by the Pneumatic Tool Department of the Ingersoll-Sergeant Drill Company, 26 Cortlandt street, New York city.



AIR HOSE COUPLING.



WROUGHT STEEL LOCKER.

WROUGHT-STEEL LOCKERS.

The half-tone shows a neat, simple and strong all-steel locker for workmen's clothing. The sides, top and bottom are of sheet metal, which may be of any thickness desired, and the perforations may be in the door only or also in the sides.

Clothing hung within is practically as well aired as if hung in the open. The lockers are made of any size, and large numbers are made of double hight or with one locker above the other. A special feature is the fastening, which, it is claimed, makes it impossible to pry the locker open or take off the door after it has been locked. The lockers are japanned and easily cleaned. They are made by the Hart & Cooley Company, New Britain, Conn.

A NEW VARIABLE-SPEED PLANER DRIVE.

The accompanying illustrations show a new motor planer drive having a variable-speed cutting stroke with a uniform return speed. The motor is a constant high-speed machine connected as shown in the engravings to the rear or constant-speed shaft by a Morse silent chain. This first or constant-speed shaft gives the return motion which, therefore, has a constant speed. The constant-speed shaft passes thru a gear box within which it is geared to the forward speed shaft by two trains of gearing each of which gives three speeds to the platen, the speed adjustment being made by the three levers attached to the housing, as shown in Fig. 2. The changes can be made when the machine is in motion or when standing still. The cutting speeds provided are 22, 27, 33, 40, 50 and 60 feet per minute, the constant return speed being 72 feet per minute. An index plate fastened to the housing, but not shown in the illustrations, shows at a glance the speed in use. Owing to the high cutting speed and the large size of the planer the driving mechanism is doubled. A complete set of driving pulleys for both cut and return is attached to each side of the machine, thus doubling the belt capacity and retaining 3½-inch belts, which are obviously much easier to shift than a single 7-inch belt would be. All the driving pulleys on the overhead shafts have heavy rims for flywheel effect in reversing the platen.

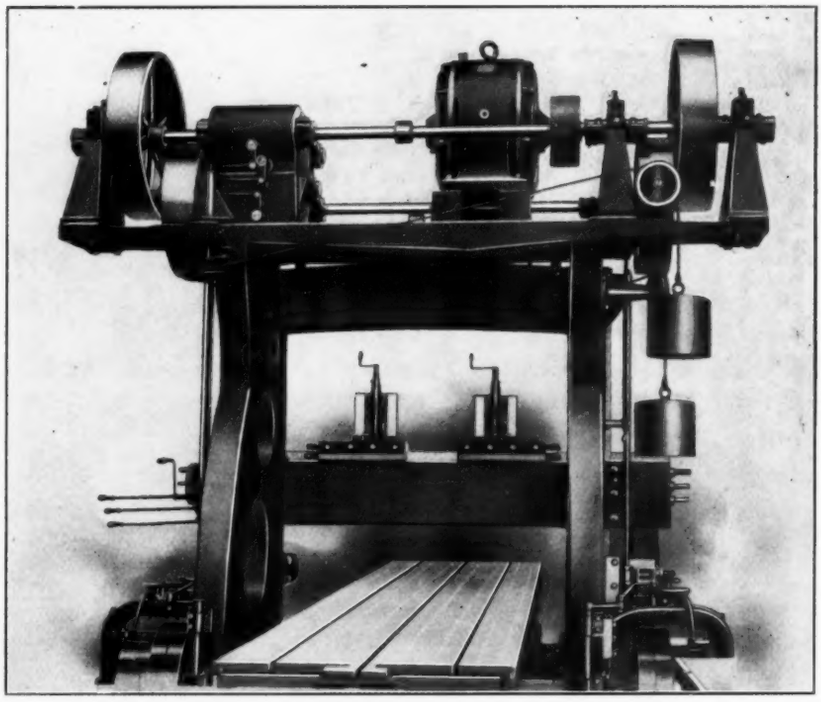


FIG. 2. REAR VIEW OF PLANER WITH VARIABLE SPEED DRIVE.

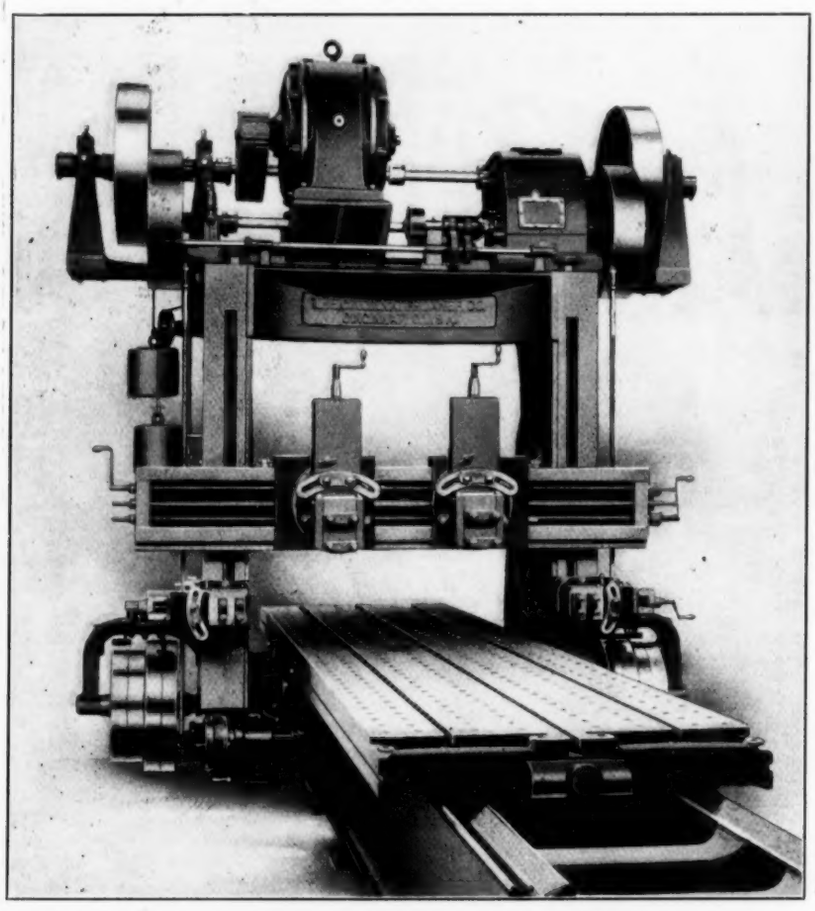


FIG. 1. FRONT VIEW OF PLANER WITH VARIABLE SPEED DRIVE.

All of the gears in the gear box are of steel and run in oil, the box being enclosed and holding about five gallons of oil. The gears carry the oil to the top of the box, whence it flows to the bearings, drain holes at the bottom permitting it to drain back into the box, thus keeping a constant flow of oil over all the moving parts.

The planer shown is a 66x60-inch by 21-foot machine, but the drive is being put in all sizes of machine made by the builders—the Cincinnati Planer Company.

Incandescent Gas Mantles by Automatic Machinery.

About as delicate a piece of manufactured work as one can imagine is the Welsbach gas mantle, of which some forty millions are made in this country annually. That these can be turned out by machinery which is practically automatic in its action will be something of a surprise to the many persons who know what fragile affairs these mantles are after their coatings are burned off. The writer recently had the privilege of examining, at the Raritan Mantle Company's factory in Chatham Square, New York, a machine invented and built by J. T. Robin, of 254 Canal street, which machine, tho requiring but two attendants, turns out about 4,500 mantles per day—or a number ordinarily requiring some fifteen hands to produce. Moreover, the work emerging from the machine is in perfect condition, and there is no loss due

to breakage in the various operations. The machine, a light but stiff framework of steel, carries a system of sprocket wheels and chains which support a series of racks for the mantle sleeves, as they come from the knitting machines and the nitrate of thorium bath. By means of the chains, row after row of sleeves are carried automatically thru the different stages of burning out the thread, shaping and hardening (over gas jets), dipping in the coating mixture (gun cotton dissolved in alcohol and mixed with castor oil and shellac), drying and trimming. There are 250 mantles in the machine at once, the greater part of these undergoing drying operations while the succeeding ones are receiving preliminary treatment. From the time a row of ten mantle sleeves enter the front of the machine until they return—*via* the endless chain—and are trimmed automatically and removed from their holders, is about twenty-five minutes.

Foreign Markets for American Machinery.

Some months ago I called attention to the demand that is arising in Egypt for refrigerating machinery. A company has been formed in England with the object of supplying Egypt with frozen meat from Australia by erecting suitable cold-storage depots in Alexandria, Port Said, Cairo, etc. Makers of this class of machinery should communicate with the Nile Cold Storage Company, London, who would give them any necessary specifications, etc.

Italy, also, is another likely country for such machinery. The Italian Minister of Agriculture is particularly anxious to encourage the knowledge and use of the best methods of food preservation throughout the kingdom. With this view he has commissioned the Director of the Royal School of Horticulture, Florence, to visit Germany and report on the refrigerating machinery used for industrial purposes in that country, more especially in Hamburg. The Director would give any information to American inquirers.

There is a steady demand in Guatemala for steam engines, hydraulic apparatus, and all kinds of machinery, most of it being supplied by the United States. Your manufacturers take the lead as against Germany and Britain, and they owe their position to the fact that everything they send out is in perfect order and can easily be fitted up and started without much technical knowledge—a knowledge which is usually lacking in Central America. Your exporters monopolize also the trade in railroad material. This is largely due to the fact that the railroad concessions are usually granted to American companies. There are several lines in course of construction throughout the country at the present time.

During the last year the importation of machinery into India reached 28 million rupees ($14,000,000). There has been a good deal of extension in the jute factories throughout Bengal, and also considerable development of the electric light and electric power installations. There has been—and the demand still continues—a heavy import of railroad material into India, the value of the trade last fiscal year being 53 million rupees, the shipments comprising engines, tenders, carriages, goods trucks, timber sleepers, iron and steel rails, etc.

The Osaka (Japan) city council has recently decided to construct an electric railway for a total length of 6 miles, at an estimated cost of 3,600,000 yen (a yen is nearly equal to a dollar). There is, in Osaka, an electric railway service running a distance of 4 miles, which was started last year, the daily average receipts being 20 yen above the estimated returns. The construction of an electric railroad is also to be undertaken running from Yukosuka (a naval station) to Uraga, a length of 6 miles, at an estimated cost of 450,000 yen. At Sizuoka (Suruga) an electric railroad company is to be established with a capital of 300,000 yen. These are some definite undertakings which will all want extensive plant of various kinds, and it will be as well if American manufacturers look after the business. The necessary local details, etc., could readily be obtained from the United States consular representatives on the spot, or from the leading importing houses.

Among various foreign business that is coming on the market is the following: The municipality of Victoria, B. C., are open to buy 12,000 feet of cast-iron water pipes, delivery in Victoria, by May 1, 1905. A strong rock dredger is wanted for the port of Alexandria, Egypt. The secretary of the Board of Administration has the control of these matters.

Spain offers several good chances of obtaining business. A meter-gage steam tramway is to be constructed from Barco de Avila to Bejar; also an electric tramway extension of existing lines in Madrid, the promoters being the Sociedad Tranvia del Este, Madrid. Makers of canal plant should note that an irrigation canal is to be constructed in the colony of General Roca, in the territory of Rio Negro, Argentina, at a cost of about £43,000.

Considerable extensions of existing railroads are to be authorized shortly by the Argentine Government at an estimated cost of over $12,500,000, thus offering excellent opportunities for American railroad engineering firms. The Director-General of Ways and Communications, Buenos Ayres, is the officer in charge of the undertaking. F. C. C.

England.

Personal.

Frank Hedley went to work for the Manhattan Elevated Railroad Company twenty years ago as a machinist at $2.60 a day. He is now made general manager of the Interborough Rapid Transit Company (the latest development of the Manhattan) at a salary of $25,000.

Edward Lindmueller, formerly designer and draftsman with the Standard Sewing Machine Company, has gone into business for himself at 884 Prospect street, Cleveland, Ohio.

M. Eugene Blin, of the French automobile manufacturing firm of Malicet & Blin, Aubervilliers, is now in this country, where he will leave orders for machine tools to the amount of about $60,000.

Business Items.

The Electric Controller & Supply Company, of Cleveland, announces the opening of its Southern branch office at 509-510 Woodward Building, Birmingham, Ala. This company is now represented in the following cities: New York, Philadelphia, Pa.; Pittsburg, Pa.; Cleveland, O.; Birmingham, Ala.; Denver, Colo.; San Francisco, Cal., and London, England.

The Northern Engineering Works, Detroit, Mich., crane builders, report among recent shipments and sales of electric and hand traveling and jib cranes, the following: United States Lighthouse Board, Detroit, two 6-ton; Van Dorn Iron Works, Cleveland, one 15-ton electric; Proximity Manufacturing Company, Greensboro, N. C., one 20-ton; Barnhart & Davis, Warren, Pa., one 5-ton; Dow Chemical Company, Midland, Mich., one 5-ton; city of Springfield, one 15-ton, with runway complete. They report a large increase in inquiries and quotations during the past month.

Manufacturers.

The Central Iron Works, Quincy, Ill., have been damaged by fire.

The plant of the Danville (Va.) Ice Company has been burned.

Ames, Ia., is voting on $28,000 bonds for a system of water-works.

A municipal electric lighting plant is proposed at Milwaukee, Wis.

The plant of the Appleton (Wis.) Wire Works will be enlarged at once.

A large factory and warehouse will be built for the Paris Plough Company, Paris, Ont.

A planing mill of Vaught, Phillips & Co., Sharpsburg, Pa., has been damaged by fire.

A new 75x150-foot building is planned for the use of the Fresno (Cal.) Agricultural Works.

The Penobscot Central Railway, Bangor, Me., may make new arrangements for getting power.

A bent wood finishing plant of C. H. Gillette & Co., Indianapolis, Ind., has been burned.

Grafton Johnson, canner, of Greenwood, Ind., and elsewhere, may establish a plant at Anderson.

The Pacific Starch Company's Jackson, Mich., factory has been almost completely destroyed by fire.

The West Virginia Sand Company's mill, north of Berkeley Springs, W. Va., has been damaged by fire.

The I., D. and W. shops of the Cincinnati, Hamilton & Dayton system at Indianapolis will probably be enlarged.

Alterations are to be made to the carpet mill of James Pollock & Son, at Tulip and Dauphin streets, Philadelphia.

The French Oil Mill Machinery Company, Piqua, O., awarded the contract for the erection of a new building, 56x100 feet, two stories.

Henry Leon, proprietor and manager of a silk mill in Bradford, Pa., is arranging for an enlargement of the factory.

It is reported that the Republic Iron & Steel Company is about to make extensive improvements at Youngstown, O.

The Commercial Club, Council Bluffs, Ia., is working for the establishment of a hay tool manufacturing plant there.

G. H. Curtiss, manufacturer of motor cycles, Hammondsport, N. Y., is building, and about to occupy, larger quarters.

The American Foundry Company, of Indianapolis, Ind., has purchased four acres, on which a building will be erected.

The Darlington (S. C.) Manufacturing Company is making arrangements to add 12,000 spindles to its equipment.

M. Craven, of Springfield, Mass., is willing to erect a large woolen factory at Columbus, Ga., if the citizens will cooperate.

The Andrews Wire & Iron Works, Rockford, Ill., are erecting, or have erected, a two-story building, 65x100 feet.

The Morgan Spring Company, Worcester, Mass., is pushing the work on a three-story, 172x70-foot addition to its plant.

A sawmill is proposed to be built in the neighborhood of Nelson, B. C., by the company headed by J. P. McGoldrick.

Improvements to cost in the neighborhood of $40,000 are to be made by the Sligo Iron & Steel Company, Connellsville, Pa.

O. P. Scott, of Indianapolis, Ind., who holds patents on an incubator, has been in Abingdon, Ill., promoting a factory.

The plant of the St. Anthony Furniture Company, St. Anthony Park, a suburb of St. Paul, Minn., has been damaged by fire.

The John Pinches Company, wood turner, etc., New Britain, Conn., has applied for permission to build an addition to its factory.

The Southern Iron & Wire Manufacturing Company is completing a factory building at Pacific avenue and Good streets, Dallas, Tex.

The Carney Lumber Company, of Massey, Ont., expects between now and next spring to invest $125,000 in a new or established mill.

The directors of the Capital City Woolen Mills Company, Des Moines, Ia., are considering the erection of an addition to the plant.

Fire at the Bethlehem Steel Works has caused damage estimated at not over $75,000, attributed to spontaneous combustion in the paint shop.

The water supply power-house at Alexandria Bay, N. Y., has been wrecked by an explosion of gasoline, caused by a spark from the dynamo.

It is reported that the Merrimack Manufacturing Company, Huntsville, Ala., will soon begin the erection of the third of its series of eight cotton mills.

A franchise for a gas plant at Chickasha, I. T., has been granted by the City Council to H. I. Martin, of Massachusetts, and A. A. Humphrey, of Guthrie, Okl.

The Peerless Motor Car Company, Cleveland, O., will build a plant on Quincy street, at the Nickel Plate crossing. Plans for a machine shop have been prepared.

The Pana, Ill., city council has granted a franchise to the Pana Gas Light, Fuel & Steam Heating Company for the erection of a plant. A. B. Corman is the promoter.

W. H. Wiley, secretary of the Commercial Club, Marion, Ind., is in touch with a gun factory project. Messrs. Cecil & House, who are said to be owners of such a factory at Wheeling, W. Va., are thinking of moving it, and have visited Marion.

New Catalogs.

The Falls Rivet & Machine Company, Cuyahoga Falls, Ohio. Descriptive pamphlet of the Wadsworth core machine. Illustrated. 6x9, pp. 15, paper.

Baldwin Locomotive Works, Philadelphia, Pa. "Record of Recent Construction," No. 48, showing some recent locomotives built by this company. Illustrated. 6x9, pp. 31, paper.

Auburn Ball Bearing Company, Rochester, N. Y. Bulletin No. 1, "Auburn Ball Bearings"; No. 5, "Testimonials"; No. 6, "Auburn Ball Thrust Bearings and Ball Thrust Washers." 4x9, paper.

Northern Engineering Works, Detroit, Mich. Bulletin No. 17, showing the line of electric trolley hoists made by this company. The bulletin is issued as a supplement to the Northern Engineering Works' crane catalog.

Sloan & Chace Manufacturing Company, Newark, N. J. Precision machinery, including bench lathes and attachments, drill presses and tapping machines, bench milling machines, automatic gear cutters and automatic pinion cutters, with full descriptions and profuse illustrations. 6x9, pp. 59, paper.

Oliver Machinery Company, Grand Rapids, Mich. General catalog containing 216 pages and well illustrated throughout. The first section is devoted to "Oliver" pattern shop and wood-working machinery, while the last section covers other machinery, tools and supplies handled by the company. The catalog is most complete and should be in the hands of all who are interested in the purchase and use of pattern shop equipment. Copies can be had upon application. 6x9, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Addressing machines for office use. Joline & Co., 123 Liberty St., New York.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago.

Shop agents wanted for my rules with handle. W. E. Severance, Revere, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light mach'y to order; model work; rubber molds. J. W. Weir, Bridgeport, Conn.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N.J.

A practical book, "Dies and Diemaking," post paid $1. J. L. Lucas, Bridgeport, Conn.

Working drawings, tracings. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Steel name and monogram name stamps; diesinking; write for estimates. J. L. Lucas, Bridgeport, Conn.

Automatic Machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Auto. machinery of all kinds designed and built; hardened and ground work, flat or circular. Wiebking, Hardinge & Co., Chicago.

Wanted—Technical man in every town; no goods to sell; no expense; professional branch of your occupation; professors, mechanical and electrical engineers and literary draftsmen so far appointed. Box 404, AM. MACH.

"Spangenberg's Steam and Electrical Engineering." By E. Spangenberg, M. E., former superintendent of the St. Louis School of Engineering, contains 1,035 questions and answers, with 648 illustrations. A complete reference book for engineers, electricians, firemen, linemen, wiremen, steam fitters and owners of steam, electric and refrigerating plants, etc. Price, $3.50. Geo. A. Zeller, publisher, 18 South Fourth st., St. Louis, Mo. 40-page pamphlet tells all about it.

For Sale.

For Sale—1 Farrel Foundry hydraulic pump and press; 800 tons; cost $1,950; will sell very reasonable; perfect condition. H. M. Crowell Mfg. Co., 6th ave. and 13th st., Newark, N. J.

For Sale—A very desirable machine and repair shop, residence, location and business; manufacture wood-sawing machinery, which is in great demand; more business than can attend to; want to retire; a bargain. Irving Fox, Rochester, Minn.

For Sale—Four Watts-Campbell Corliss engines, 24x56; 400 horse-power at 100 lbs. steam pressure; 70 revolutions per minute; flywheel—diameter 20 ft., face 46 in.; condition first class. One double Watts-Campbell Corliss engine, 18x42; 250 horse-power at same pressure; 91 revolutions per minute; flywheel—diameter 16 ft., face 32 in. One N. Y. Safety engine, 12x12; 75 horse-power at same pressure; 250 revolutions per minute; 2 belt wheels, 4½ ft.; diameter 17½ in. and 13 in. face. Will sell singly. Can be seen in New York city by addressing The United Electric Light & Power Company, 1170 Broadway, New York city.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Machine shop foreman; wide experience; automatic machinery and machine tools; age 34. Box 420, AMERICAN MACHINIST.

ILLINOIS.

Wanted—By an experienced man, a position as foundry foreman; references given. Box 419, AMERICAN MACHINIST.

NEW JERSEY.

Pattern shop foreman wishes position; 20 years' experience. Box 408, AMER. MACH.

Position as chief draftsman or designer, after Nov. 15, with firm building D. C. motors, generators or rotary converters; large machines preferred. Box 400, AMER. MACH.

Thorough mechanic, age 28, energetic, inventive and executive ability, having charge 8 years, desires change; steam or gas engines preferred. Box 438, AMER. MACHINIST.

NEW YORK.

Toolroom foreman experienced in gas, steam engines, turbines, etc. Box 431, A. M.

Toolmaker, first class, accustomed to fine work, desires position, or take charge. Box 422, AMERICAN MACHINIST.

Position as toolroom or machine shop foreman; 8 years as foreman; practical; first-class references. Box 439, AMER. MACH.

General foreman or foreman; up to date, experienced, practical, also familiar with automobile work. Box 429, AMER. MACH.

Experienced machinist, occasional contributor to this paper, steady, 35, wants job, in or outside. Box 432, AMERICAN MACHINIST.

Machinist; 8 years' general experience, also technical training; prefer experimental or electrical work. Box 434, AMER. MACHINIST.

Engineer, with European and American experience in building and designing steam turbines and centrifugal pumps, wants to change. Box 437, AMERICAN MACHINIST.

General foreman, responsible man, progressive, expert machinist, vast experience in duplicate and general machinery, is open for engagement. Box 440, AMER. MACHINIST.

Foreman; specialty light manufacturing interchangeable work; good executive; well up on factory system, cost, etc.; best of references. Box 436, AMERICAN MACHINIST.

Superintendent; expert mechanic; good systematizer and cost reducer; can handle men to get best results; expert on explosive engines; first-class references. Box 428, A. M.

Mechanical draftsman, 11 years' practical experience, would accept position as assistant

superintendent or designer on jigs, special tools or automatic machinery. Box 433, A. M.

Draftsman, familiar with pneumatic tool construction and fixtures, desires position in this line or with party prepared to equip new shop; able to superintend work of equipment in all details. Box 430, AMER. MACH.

Mechanical engineer, graduate of German university, with several years' experience in constructing all kinds of cranes, derricks, hoists, etc., will be open for engagement by October 15. Box 425, AMERICAN MACHINIST.

General foreman, good executive, thorough mechanic, with special experience and ability in elevator manufacturing, also with up-to-date shop methods and management, is open for position. Box 441, AMERICAN MACHINIST.

Position as foreman in gray iron foundry, by a practical molder; good melter and mixer; 16 years' foundry experience; last 4 years as foreman in jobbing foundry; lots of experience on gasoline engine castings; best of references. E. J. H., care AMER. MACH.

OHIO.

Experienced mechanical draftsman wishes to change; gas engines, jigs and tools; 7 years shop and 3 years drawing room. Box 435, AMERICAN MACHINIST.

PENNSYLVANIA.

College graduate (M. E.), experienced in designing general machinery and in executive capacities; references. Box 412, AM. MACH.

Mechanical engineer, 7 years' experience in manufacture of power plant machinery, wants position; good designer and draftsman with business experience. Box 424, AMER. MACH.

Mechanical draftsman, German, college graduated, 2 years' shop experience, 2 years' office experience in America and Germany, wants position; will go anywhere. Box 446, AMERICAN MACHINIST.

Position as draftsman; 3 years' experience in drawing room, 10 years in machine shop; experienced on machinery for production of cold drawn steel, milling machines, etc.; references. Box 442, AMERICAN MACHINIST.

Mechanical engineer wants responsible position; technical educated, with 10 years' experience as machinist and designer in light and heavy machine tools, jigs, fixtures and interchangeable work; familiar with modern shop equipments, thoroughly up to date, hustler and hard worker; best references. Box 423, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CALIFORNIA.

Wanted—An experienced and successful salesman, familiar with high-grade pumping machinery in all its branches; only those who can show a successful record and who are now similarly employed will receive consideration; state experience fully, age, salary expected and when ready to report here. Apply Box 443, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—First-class machine designer, familiar with automatic machinery; must have had ample experience; position pays at present $100 per month. Address Drawer "K," Holyoke, Mass.

NEW YORK.

Wanted—Tool dresser on machine tools. The Goulds Mfg. Co., Seneca Falls, N. Y.

Good instrument makers desiring steady employment will find it to their advantage to apply to the Spencer Lens Co., Buffalo, N. Y.

Wanted—Several good draftsmen on light construction work; must have several years' experience; state age, salary expected and references. Box 445, AMER. MACHINIST.

Wanted—First-class wood pattern makers; experienced on valve work and hydrants preferred; in replying, state age and wages expected. Address Box 427, AMER. MACHINIST.

Mechanical draftsman wanted for automobile work; must have gasoline engine experience; state age, salary expected and experience. Black Diamond Auto. Co., Wm., Dieter, Mgr., Utica, N. Y.

OHIO.

Wanted—Chief engineer (mechanical) with executive ability and originality for plant manufacturing cranes and special machinery; state age, experience and salary expected. Box 395, AMERICAN MACHINIST.

Wanted—Mechanical engineer and draftsman, experienced in modern engine building and general engineering, to take charge of engineering department in northwestern Ohio. Address Box 410, AMERICAN MACHINIST.

Wanted—Thorough mechanic; one who can take charge of designing and laying out of work for 20 toolmakers on jigs, tools and fixtures for the manufacture of light, high-class, interchangeable work. Box 338, A. M.

PENNSYLVANIA.

Wanted—Shop foreman, thoroughly experienced in die and drop forged work, to start with new plant now building, with most modern equipment and design. Box 444, AM. M.

The Monotype Company maintains a school to train young men to meet the constantly increasing demand for operators of its type casting and composing machine. These operators have done so well that it receives more applications for places than can be filled. In making selections these qualifications carry most weight: common sense, type foundry experience, printing office experience, automatic machinery experience. Full particulars will be furnished to inquirers who furnish the same information about themselves. The Lanston Monotype Machine Co., 1231 Callowhill st., Philadelphia, Pa.

VERMONT.

Wanted—A foundry foreman to take charge of gray iron foundry; give experience and reference. Address "R.," care AM. MACH.

WEST OF MISSISSIPPI.

A clean, upright man with $2,000 to $10,000 to invest and act as the mechanical head of a large, successful gas engine works; a free hand to a competent and experienced gas engine cost reducer. Witte Iron Works Co., Kansas City, Mo.

WISCONSIN.

Wanted—A young man of experience to take charge of advertising and catalog matter for machine tool manufacturer, also sales correspondence; give references and state salary. Box 426, AMERICAN MACHINIST.

Wanted—A mechanical engineer, experienced in traveling crane work, who has unquestioned ability to take entire charge of drawing room and the management of the work and men in that department; one who has held similar position will be given preference; to the right party a splendid opportunity is offered. Box 377, AMER. MACH.

Alphabetical Index to Advertisers.

	PAGE
Acme Machinery Co	34
Adams Co., The	126
Ajax Mfg. Co.	178
Albro-Clem Elevator Co.	149
Allen, John F.	168
Almond Mfg. Co., T. R.	165
Alteneder & Sons, Theo.	164
Aluminum Check Co.	180
American Blower Co.	162
American Gas Furnace Co.	26
American Pulley Co.	132
American School of Correspondence	179 and 181
American Steam Gauge & Valve Mfg. Co.	154
American Tool Works Co.	8
American Watch Tool Co.	123
Armstrong Bros. Tool Co.	110
Athol Machine Co.	149
Atkins & Co., E. C.	110
Auburn Ball Bearing Co.	168
Audel & Co., Theo.	85
Aurora Tool Works	182
Automatic Machine Co.	124
Automatic Machine Co.	174
Backus Water Motor Co.	136
Badger & Sons Co., E. B.	139
Baird & Co., Henry Carey	182
Baird Machinery Co.	185
Baker Brothers	138
Baldwin & Wight	164
Ball Bearing Co.	34
Bantam Mfg. Co.	95
Barnes Co., B. F.	119
Barnes Co., W. F. & John	14
Barnett Co., G. & H.	4th Cover
Bartlett, E. E.	148
Bates Machine Co.	164
Bath Grinder Co.	180
Baush Machine Tool Co.	104
Baush, W. H.	184
Bay State Stamping Co.	163
Bayldon Machine & Tool Co.	182
Beaman & Smith Co., The	15 and 130
Becker-Brainard Milling Machine Co.	25
Belmer Machine Tool Co.	133
Bemis & Call Hardware & Tool Co.	154
Bertram & Sons Co., Ltd., John	31
Bertsch & Co.	26
Besly & Co., Chas. H.	122
Bethlehem Fdry. & Mch. Co.	120
Betts Machine Co.	6
Bickford & Co., H.	93
Bickford Drill & Tool Co.	1
Bignall & Keeler Mfg. Co.	154
Bilgram, Hugo	34
Billings & Spencer Co.	4th Cover
Binsse Machine Co.	34
Blaisdell & Co., P.	122
Blaisdell Machinery Co.	167
Blanchard Mach. Co.	34 and 167
Bliss Co., E. W.	23
Blount & Co., J. G.	134
Boker & Co., Hermann	152
Boston Gear Works	134
Bowser & Co., S. F.	135
Boynton & Plummer	127
Bradford Machine Tool Co.	5
Brightman Mfg. Co.	152
Bristol Co.	4th Cover
Brown & Co., R. H.	130
Brown & Sharpe Mfg. Co.	79, 103 and 4th Cover
Brown Hoisting Mach. Co.	150
Buffalo Forge Co.	183 and 4th Cover
Builders Iron Foundry	3d Cover
Bullard Machine Tool Co.	32
Bultman & Co., F. H.	148
Burr & Sons, John T.	149
Burt Mfg. Co.	31
Butler, A. G.	163
Byram & Co.	139
Caldwell & Son Co., H. W.	170
Cambridge Scientific Instrument Co.	140
Capital Gas Engine Co.	136
Carborundum Co., The	176
Card Mfg. Co., S. W.	30
Carpenter Tap & Die Co., J. M.	28
Case Mfg. Co.	150
C & C Electric Co.	156
Chadwick & Co., G. B.	130
Chambersburg Engr. Co.	171
Chandler & Farquhar	185
Chattanooga Machinery Co.	162
Chicago Flexible Shaft Co.	114
Chicago Rawhide Mfg. Co.	148
Christensen, N. A.	168
Cincinnati Mach. Tool Co.	113
Cincinnati Milling Mach. Co.	7
Cincinnati Planer Co.	12
Cincinnati Punch & Shear Co.	138
Cincinnati Screw & Tap Co.	166
Cincinnati Shaper Co.	186
Clapp Mfg. Co., E. D.	139
Clark, Jr., & Co., Jas.	168
Clayton Air Compressor Wks.	169
Cleveland Auto. Mach. Co.	106
Cleveland Cap Screw Co.	155
Cleveland Crane & Car Co.	150
Cleveland Gear Works	148
Cleveland Pneumatic Tool Co.	
Cleveland Twist Drill Co.	99 and 4th Cover
Clough, R. M.	170
Coates Clipper Mfg. Co.	107
Coes Wrench Co.	170
Colburn Machine Tool Co.	10
Colonial Steel Co.	155
Consolidated Press & Tool Co.	24
Cook Co., Asa S.	130
Crane Co.	136 and 163
Cregar Agency, J. W.	185
Cresson Co., Geo. V.	139
Crocker-Wheeler Co.	158
Crosby Stm. Gage & Valve Co.	19
Cumberland Steel Co.	171
Curtis & Co. Mfg. Co.	168
Curtis & Curtis Co.	24
Cushman Chuck Co.	130
Dallett Co., Thomas H.	162
Davis Machine Co., W. P.	102
Derry-Collard Co.	93
Desmond-Stephan Mfg. Co.	95
Detrick & Harvey Machine Co.	166
Detroit Lubricator Co.	133
Diamond Drill & Mch. Co.	144
Diamond Machine Co.	3d Cover
Diamond Saw & Stamping Works	171
Dickinson, Thos. L.	135
Dill Machine Co., T. C.	113
Dixon Crucible Co., Joseph	163
Dodge & Day	175
Dreses Machine Tool Co.	172
Dwight Slate Machine Co.	148
Earle Gear & Mach. Co.	148
Eberhardt Bros. Machine Co.	148
Electric Controller & Supply Co.	160
Elmes Eng. Works, Chas. F.	133
Emmert Mfg. Co.	175
Errington Auto. Tap & Die Co.	131
Estep & Dolan	134
Evans Friction Cone Co.	150
Excelsior Needle Co.	116
Faber, Jr., A. E.	95
Fairbanks Co.	92
Falkenau-Sinclair Mach. Co.	24
Faneuil Watch Tool Co.	3d Cover
Farrel Fdry. & Machine Co.	153
Fawcus Machine Co.	146
Fay & Scott	111
Federal Mfg. Co.	91
Fellows Gear Shaper Co.	183
Felton, Sibley & Co.	163
Fenn-Sadler Machine Co.	138
Fidelity Electric Co.	162
Field, Chas. H.	133
Firth-Sterling Steel Co.	152
Flather & Co.	124
Foos Gas Engine Co.	136
Foote Bros. Gear & Mach. Co.	149
Foote, Pierson & Co.	94
Fosdick Machine Tool Co.	15
Foster Co., The Walter H.	179
Franklin Mfg. Co.	140
Frasse Co.	163
Frick Co.	136
Fritz & Goeldel Mfg. Co.	164
Ganschow, Wm.	149
Gardam & Son, Wm.	163
Garden City Fan Co.	162
Garvin Machine Co., The	170
Gay & Ward, Inc.	83
Gem Mfg. Co.	146
General Electric Co.	156
General Pneumatic Tool Co.	167
Geometric Drill Co.	129
Gisholt Machine Co.	143
Gleason Works	4th Cover
Globe Machine & Stamping Co.	137
Goldschmidt Thermit Co.	152
Goodell Mfg. Co.	163
Goodell-Pratt Co.	128
Gorton Machine Co., Geo.	134
Gould & Eberhardt	85
Graham Mfg. Co.	149
Grant Gear Works	148
Grant Mfg. & Machine Co.	163
Gray Co., G. A.	34
Gray's Ferry Machine Co.	171
Greaves, Klusman & Co.	135
Greenwald Co., I. & E.	149

PAGE

Hammacher, Schlemmer & Co. 91
Hampden Corundum Wheel Co. 130
Hardinge Bros. 123
Harrington, Son & Co., Inc., Edw. 118
Harris Oil Co., A. W. 109
Harrison, H. K. 136
Hart Mfg. Co. 139
Hartford Blower Co. 149
Hartford Steam Boiler Insp. & Ins. Co. 136
Heald Machine Co. 154
Hendey Machine Co. 87
Henley Pub. Co., Norman W. 95
Heppenstall Forge & Knife Co. 137
Herron & Bury Mfg. Co. 169
Hess-Bright Mfg. Co. 142
Hill, Clarke & Co. ..... 89 and 185
Hill, Louis A. 164
Hilles & Jones Co. 184
Hisey-Wolf Machine Co. 17
Hoefer Mfg. Co. 12
Hoggson & Pettis Mfg. Co. 130
Hollingsworth, Samuel 168
Holtzer-Cabot Elec. Co. 171
Hopkinson Machine Works 182
Horsburgh & Scott Co. ..... 4th Cover
Horton & Son Co., E. 130
Houghton & Co., E. F. 121
Howard Iron Works 133
Howson & Howson 164
Hubley Mfg. Co. 168
Hunt Co., C. W. 150
Hunt & Co., Robt. W. 28
Hurlbut-Rogers Machine Co. 129
Hyatt Roller Bearing Co. 137

Ingersoll Milling Mach. Co. 135
Ingersoll-Sergeant Drill Co. 169
International Corres. Schools. 125
International Power Vehicle Co. 136
International Specialty Co. 120
Iroquois Machine Co. 161

Jacobs Mfg. Co. 130
Jacobson Mach. Mfg. Co. 136
Jantz & Leist Electric Co. 161
Jeffrey Mfg. Co., The 184
Jenkins Brothers 163
Johnson Machine Co., Carlyle. 141
Jones & Lamson Machine Co. 20, 21 and 34

Kelly Co., R. A. 119
Kempsmith Mfg. Co. 16
Kent & Co., Edwin R. 152
Keuffel & Esser Co. 164
King, Hugh E. 171
King Machine Tool Co. 18
Kinsey-Burt Co. 178
Knecht Bros. Co. 134

Landis Machine Co. 173
Landis Tool Co. 81
Lane Mfg. Co. 150
Lang Co., G. R. 133
Le Blond Machine Tool Co., R. K. ..... 4th Cover
Le Count, Wm. G. 130
Lewis, Frank D. 170
Link-Belt Engineering Co. 172
Lodge & Shipley Mch. Tool Co. 4
Lombard & Co. 121
Long & Allstatter Co., The 181
Lucas Machine Tool Co. 111

PAGE

Lufkin Rule Co. 165
Lunkenheimer Co., The 163

McCabe, J. J. ..... 131 and 184
McCrosky Mfg. Co., F. B. 137
McGeorge & Sons 152
Macleod & Co., Walter 135
Maris Bros. 151
Marshall & Huschart Mch. Co. 185
Marston & Co., J. M. 139
Massachusetts Tool Co. 112
Massey Machine Co. 167
Mechanics Machine Co. 28
Meisel Press & Mfg. Co. 134
Mergenthaler Co., Ott 123
Merrell Mfg. Co. 133
Merrill Bros. 149
Merritt & Co. 166
Messmer Mfg. Co., Ferd. 148
Miami Valley Mach. Tool Co. 173
Mietz, A. 136
Millers Falls Co. 138
Miner & Peck Mfg. Co. 171
Modern Machinery Co. 168
Modern Tool Co. 139
Moline Tool Co. 125
Montgomery & Co. ..... 133, 134, 138, 152 and 166
Morse Chain Co. 182
Morse Twist Drill & Mach. Co. 33
Morton Mfg. Co. 134
Motch & Merryweather Co. 185
Mueller Mach. Tool Co. 126
Mutual Mfg. Co. 121

National-Acme Mfg. Co. 186
National Automatic Tool Co. 116
National Separator & Mach. Co. 150
New Britain Machine Co. 120
New Era Gas Engine Co. 136
New Haven Mfg. Co. 141
New Process Raw Hide Co. 147
Newton Mach. Tool Wks., Inc. 11
Ney, R. W. 164
Nicholson & Co., W. H. 114
Nicholson File Co. 17
Niles-Bement-Pond Co. ..... 184, 187, 188, 189 and 190
Nolte Brass Co. 166
Northampton Emery Wheel Co. 138
Northern Electrical Mfg. Co. 156
Northern Engineering Works. 150
Norton Emery Wheel Co. 127
Norton Grinding Co. 115
Nuttall Co., R. D. 148
Nutter, Barnes & Co. 28

Obermayer Co., S. 166
O. K. Tool Holder Co. 28
Olds Gasoline Engine Works. 136
Oliver Machinery Co. 121
Osgood, J. L. 142
Oster Mfg. Co. 28
Owen Machine Tool Co. 108

Parker Co., Chas. 149
Patterson, Gottfried & Hunter, Ltd. 33
Patterson Tool & Supply Co. 173
Pawling & Harnischfeger 150
Paxson Co., J. W. 137
Pelton & Crane 171
Perkins Machine Co. 22
Philadelphia Bourse 132
Philadelphia Gear Works 148
Philadelphia Pneu. Tool Co. 167

PAGE

Philips Pressed Steel Pulley Works 96
Phoenix Mfg. Co. 185
Phosphor Bronze Smelting Co. 152
Pittsburg Blue Print Co. 164
Pond Mach. & Foundry Co., L. W. 98
Poole Co., J. Morton 27
Post Co., Frederick 97
Potter & Johnston Mach. Co. 87
Pratt Chuck Co. 128
Pratt & Whitney Co. ..... 2 and 3
Prentiss Tool & Supply Co. 184
Pryibil, P. 127

Queen City Machine Tool Co. 173

Rand Drill Co. 167
Ransom Mfg. Co. 150
Reece Co., E. F. 28
Reed Mfg. Co. 149
Reeves Pulley Co. 151
Regal Gasoline Engine Co. 136
Reliance Machine & Tool Co. 130
Remy Electric Co. 136
Rhodes, L. E. 135
Rich, J. & G. 164
Ridgway Dynamo & Engine Co. 159
Rivett-Dock Co. ..... 3d Cover
Robbins & Myers Co., The 161
Rochester Die Shaper Co. 166
Rogers & Hubbard Co. 28
Rogers, Boat, Gage & Drill Works, John M. 108
Roth Bros. & Co. 162
Royersford Fdry. & Mach. Co. 138

Safety Emery Wheel Co. 122
Saunders' Sons, D. 137
Sawyer, Ezra 139
Sawyer Gear Works 148
Schellenbach & Radcliffe 31
Schieren & Co., Chas. A. 89
Schumacher & Boye 9
Schwerdtle Stamp Co. 182
Scranton & Co., The 161
Scranton Whetstone & Abrasive Wheel Co. 168
Sebastian Lathe Co. 93
Sellers & Co., Inc., William 34
Seneca Falls Mfg. Co. 109
Severance, W. E. 164
Shelby Steel Tube Co. 150
Shepard Lathe Co. 134
Shultz Belting Co. 34
Sibley Machine Tool Co. 130
Simonds Mfg. Co. 148
Skinner Chuck Co. 130
Sloan & Chace Mfg. Co. 100
Slocomb Co. J. T. 29
Smith Countershaft Co., The. 149
Smith & Mills 166
Smith, Ernst G. 164
Smith Fdry Supply Co., J. D. 152
Solid Steel Tool & Forge Co. 139
Spacke Mach. Co., F. W. 148
Spaulding Print Paper Co. 164
Speed Changing Pulley Co. 151
Sprague Electric Co. 160
Springfield Machine Tool Co. 118
Standard Brazing Co. 125
Standard Connecting Rod Co. 180
Standard Engineering Works. 137
Standard Gauge Steel Co. 26
Standard Pressed Steel Co. 150
Standard Roller Bearing Co. 126
Standard Tool Co. 117

PAGE

Standard Welding Co. 97
Starrett Co., L. S. 117
Steel Set Diamond Co. 152
Steffey Mfg. Co. 136
Steptoe Shaper Co., John 25
Stetson, R. O. 164
Stevens, F. B. 152
Stoever Foundry & Mfg. Co. 166
Stow Mfg. Co. 161
Straley, Hasbrouck & Schloeder 164
Struthers-Wells Co. 180
Stuart's Foundry & Mach. Co. ..... 4th Cover
Sturtevant Co., B. F. 13
Sutton Co., C. E. 138
Sweet, C. F. 166
Syracuse Twist Drill Co. 133

Taylor, Wilson & Co. 146
Thompson & Son Co., Henry G. 95
Three Rivers Tool Co. 25
Tindel-Morris Co. 137
Toledo Machine & Tool Co. 24
Toomey, Frank 180
Triumph Electric Co. 161
Trump Brothers Machine Co. 130

Underwood & Co., H. B. 145
Union Drawn Steel Co. 153
Universal Drafting Mach. Co. 165

Vanderbeek Tool Works 171
Vandyck-Churchill Co. 10
Van Nostrand Co., D. 180
Vaughn, Turner & Taylor Co. 182
Veeder Mfg. Co. 182
Vitrified Wheel Co. 120

Walker & Co., O. S. 28
Wallace Supply Co. 136
Ward & Sons, Edgar T. 152
Warner & Swasey Co. 94
Warner Instrument Co. 101
Waterbury Farrel Foundry & Mach. Co. 24
Watson-Stillman Co. 105
Wells Bros. Co. 29
Westcott Chuck Co. 130
Western Tool & Mfg. Co. 132
West Haven Mfg. Co. ..... 132 and 4th Cover
Westinghouse Elec. & Mfg. Co. 157
Westmacott Co., J. M. 28
Whitcomb Mfg. Co. 177
Whitman & Barnes Mfg. Co. 170
Whitney Mfg. Co. 77
Whiton Mach. Co., D. E. 131
Wickes Bros. 150
Wiley & Russell Mfg. Co. 112
Williams & Co., J. H. 139
Williams, Brown & Earle 164
Williams Tool Co. 171
Wilmarth & Morman Co. 107
Winkley Co. 133
Woodward & Powell Planer Co. 16
Woolley Fdry. & Mach. Works. 136
Worcester Mach. Screw Co. 166
Worcester Polytechnic Institute 150
Wormer Machinery Co., C. C. 184
Wuichet, Louis 179
Wyman & Gordon ..... 4th Cover

Yale & Towne Mfg. Co. 124

Zeh & Hahnemann 175

Classified Index of Articles Advertised.

Abrasive Materials

Carborundum Co., Niagara Falls, N. Y.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Scranton Whetstone & Abrasive Wheel Co., Scranton, Pa.
Vitrified Wheel Co., Westfield, Mass.

Acetylene Machines

Macleod & Co., Walter, Cin., O.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Ball Bearings

See Roller Bearings.

Balls, Steel

Federal Mfg. Co., Cleveland, O.

Band Saws, Metal

Greaves, Klusman & Co., Cin., O.
Niles-Bement-Pond Co., New York.
Oliver Mchy. Co., Grand Rapids, Mich.
Thompson, Son & Co., Henry G., New Haven, Conn.

Barrels, Tumbling

Globe Machine & Stamping Co., Cleveland, O.

Bars, Boring

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Engr. Wks., Chas. F., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Belt Dressing

Dixon Crucible Co., Jos., Jersey City, N. J.
Harris Oil Co., A. W., Prov., R. I.
Houghton & Co., E. F., Phila., Pa.

Belt Filler

Schieren & Co., Chas. A., New York.

Belt Lacing Machine

Diamond Drill & Mach. Co., Birdsboro, Pa.

Belting, Leather

Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Bending Machinery, Plate

Bertsch & Co., Cambridge City, Ind.
Cincinnati Punch & Shear Co., Cincinnati, O.
Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Toledo Mach. & Tool Co., Toledo, Ohio.
Wickes Bros., New York.

Bending Machines, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Ajax Mfg. Co., Cleveland, O.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Niles-Bement-Pond Co., New York.

Bending Tools, Hand

Estep & Dolan, Sandwich, Ill.
Wallace Supply Co., Chicago, Ill.

Blocks, Chain

See Hoists, Hand.

Blocks, Size

Meisel Press & Mfg. Co., Boston, Mass.

Blowers

American Blower Co., Detroit, Mich.
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Garden City Fan Co., Chicago, Ill.
Hartford Blower Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Machine Dept.—Chain Dept.—"Woodruff" Key Dept.

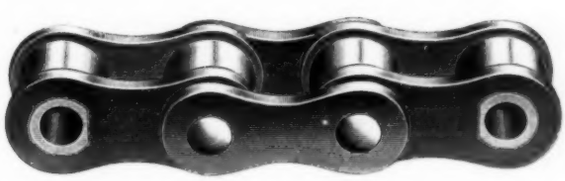
Patented Sept., 1904

Victory for "Whitney" Roller Chain Standards.

Question Settled by Road Tests and Remarkable Records.

It Looks Very Much as if "Whitney" Chains and Standards Were Now Used Exclusively on the Following Automobiles.

"Cadillac," "Rambler," "Knox," "Ford," "Franklin," "Columbia," "Pope-Hartford," "Stearns," "Acme," "Queen," "Wayne," "Mitchell," "Olds Runabout," "Pierce-Racine," "Moline," "Auto-Car Equipment," "Sommer," "Matheson," "Baker," "Corbin," "Tourist," "Gaeth," "Springfield," "Manhattan," "Worthington," "Lenawee," "Cotta," "Gibbs," "Elwell-Parker," "Western Electric," "Snell."



We Never Expect To Stop Making Improvements.

THE WHITNEY MFG. COMPANY,

HARTFORD, CONN., U. S. A.

Blue Print Machines
Keuffel & Esser Co., New York.
Pittsburg Blue Print Co., Pittsburg, Pa.
Spaulding Print Paper Co., Boston, Mass.
Williams, Brown & Earle, Philadelphia, Pa.

Blue Print Wringers
Pittsburg Blue Print Co., Pittsburg, Pa.

Boilers
Struthers-Wells Co., Warren, Pa.
Wickes Bros., New York.

Boiler Tube Cleaners
Gem Mfg. Co., Pittsburg, Pa.

Bolt and Nut Machinery
Acme Mchry. Co., Cleveland, O.
Ajax Mfg. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Howard Iron Wks., Buffalo, N. Y.
Landis Machine, Waynesboro, Pa.
Lang Co., G. R., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Reliance Mach. & Tool Co., Cleveland, O.
Standard Engineering Works, Ellwood City, Pa.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Williams Tool Co., Erie, Pa.

Bone for Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Books, Mechanical
American School of Correspondence, Chicago, Ill.
Audel & Co., Theo., New York.
Baird & Co., Henry Carey, Philadelphia, Pa.
Derry-Collard Co., New York.
Henley Pub. Co., Norman W., New York.
Modern Mchry. Co., Chicago, Ill.
Van Nostrand Co., D., New York.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Meadville Vise Co., Meadville, Pa.
Motch & Merryweather Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia Pa.
Niles-Bement-Pond Co., New York. York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bickford & Co., H., Lakeport, N. H.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Foster Co., Walter H., New York.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Brakes, Magnetic Friction
Electric Controller & Supply Co., Cleveland, O.

Brazing
Standard Brazing Co., Boston, Mass.

Broaching Machines
Burr & Sons, John T., Brooklyn, N. Y.

Bulldozers
Ajax Mfg. Co., Cleveland, O.
Toledo Mach. & Tool Co., Toledo, Ohio.

Cabinets, Oil
Bowser & Co., S. F., Fort Wayne, Ind.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.

Calipers, Sliding
Smith, Ernst G., Columbia, Pa.

Carborundum
See Grinding Wheels.

Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Castings, Brass and Bronze
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Diamond Drill & Mch. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Hubley Mfg. Co., Lancaster, Pa.
Massey Mach. Co., Watertown, N. Y.

Castings, Motor
Harrison, H. K., St. Paul, Minn.
Steffey Mfg. Co., Phila., Pa.

Castings, Steel
Diamond Drill & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.

Centering Machines
Hendey Mach. Co., Torrington, Conn.
Kempsmith Mfg. Co., Milwaukee, Wis.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.

Chain-Making Machinery
Vaughn, Turner & Taylor Co., Cuyahoga Falls, Ohio.

Chains, Driving
Boston Gear Works, Boston, Mass.
Federal Mfg. Co., Cleveland, O.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Charts
Derry-Collard Co., New York.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.

Chucks, Drill—*Continued*
Jacobs Mfg. Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Gisholt Mach Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Magnetic
Walker & Co., O. S., Worcester, Mass.

Chucks, Planer
Niles-Bement-Pond Co., New York.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.
Hardinge Bros., Chicago, Ill.

Circuit Breakers
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Faneuil Watch Tool Co., Boston, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Clutches, Magnetic and Electrical
Electric Controller & Supply Co., Cleveland, O.

Coils
Standard Welding Co., Cleve., O.

Compound, Boiler
Harris Oil Co., A. W., Provi., R. I.

Compound, Drilling
Sweet, C. F., Hartford, Conn.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Machy. Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Rand Drill Co., New York.

Connecting Rods and Straps
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.
Gray's Ferry Mach. Co., Philadelphia, Pa.
Meisel Press & Tool Co., Boston, Mass.
Pope Mfg. Co., New York.

Controllers and Starters, Electric Motor
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Cincinnati Punch & Shear Co., Cincinnati, O.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Counterbores
Clough, R. M., Tolland, Conn.
Slocomb Co., J. T., Provi., R. I.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry. Provi., R. I.
Power & Speed Controller Co., Boston, Mass.
Smith Countershaft Co., Melrose, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Electric Controller & Supply Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.

Cranes
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Wickliffe, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Lane Mfg. Co., Montpelier, Vt.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer & Co., S., Cincin., O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.

Crank Pin Turning Machine
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Byram & Co., Detroit, Mich.
Northern Engr. Works, Detroit, Mich.
Obermayer & Co., S., Cincin., O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
Gay & Ward, Inc., Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Whitney Mfg. Co., Hartford, Ct.

BROWN & SHARPE MANUFACTURING CO.

PROVIDENCE, R.I., U.S.A.

UNIVERSAL MILLING MACHINES.

THE ONLY MACHINES REGULARLY EQUIPPED WITH DIFFERENTIAL INDEXING.

The Change Gears and Index Plates provide for all divisions from 1 to 382, including all the prime numbers, and enable the divisions to be made with no more care than is required in Plain Indexing.

The Table is plainly and conveniently made up. Indexes both Plain and Differential Indexing. Fractional Spacing an important feature.

Other features of the Spiral Head—Adjustable Index Crank, enables adjustments to be made without disturbing the setting of the work. Graduated Index Sector, enables settings to be made without the necessity of counting the number of holes required in a given circle.

DESCRIPTIVE BOOKLET MAILED TO ANY ADDRESS UPON APPLICATION.

SEE PAGE 103.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Burr & Sons, John T., Brooklyn, N. Y.
Davis Mach. Co., W. P., Rochester, N. Y.
Fawcus Macnine Co., Pittsburg, Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Goodell Mfg. Co., Greenfield, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, O.

Diamond Tools
Dickinson, Thos. L., New York.
Osgood, J. L., Buffalo, N. Y.
Steel Set Diamond Co., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Gem Mfg. Co., Pittsburg, Pa.
Globe Machine & Stamping Co., Cleveland, O.
Perkins Mach. Co. Warren, Mass.
Toledo Mach. & Tool Co., Toledo, Ohio.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Winkley Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Fritz & Goeldel Mfg. Co., Grand Rapids, Mich.
Keuffel & Esser Co., New York.
Rich, J. & G., Philadelphia, Pa.
Williams, Brown & Earle, Philadelphia, Pa.

Drawing Inks
Post Co., Frederick, New York.

Drawing Materials
Alteneder & Sons, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.
Post Co. Frederick, New York.
Williams, Brown & Earle, Philadelphia, Pa.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Mutual Mfg. Co., Bridgeport, Ct.
Patterson Tool & Supply Co., Dayton, O.
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Aurora Tool Wks., Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks., Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.

Drilling Machines, Multiple Spindle—*Continued*
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Machine Co., Hartford, Conn.
Flather Planer Co., Mark, Nashua, N. H.
Fosdick Mach. Tool Co., Cin., O.
Gardam & Son, Inc., Wm., New York.
Garvin Mach. Co., New York.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
National Auto. Tool Co., Dayton, Ohio.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.

Drilling Machines, Pneumatic
Allen, Jno. F., New York.
Cleveland Pneu. Tool Co., Cleveland, O.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Rand Drill Co., New York.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck-Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.
Vanderbeek Tool Wks., Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Wks., Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Faber, Jr., A. E., Plainfield, N. J.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincinnati, O.
Gardam & Son, Inc., Wm., New York.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Knecht Bros. Co., Cincinnati, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanics Machine Co., Rockford, Ill.
Moline Tool Co., Moline, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Patterson Tool & Supply Co., Dayton, O.

Drilling Machines, Upright *Continued*
Prentiss Tool & Supply Co., New York.
Sibley Machine Tool Co., South Bend, Ind.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck-Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drills, Rail
Niles-Bement-Pond Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

Drying Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Dynamos
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Fidelity Elec. Co., Lancaster, Pa.
General Electric Co., New York.
Holtzer-Cabot Elec. Co., Brookline, Mass.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Boston, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
Clark, Jr., & Co., Jas., Louisville, Ky.
Electric Controller & Supply Co., Cleveland, O.
Fidelity Electric Co., Lancaster, Pa.
General Elec. Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Clark, Jr., & Co., Jas., Louisville, Ky.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Standard Tool Co., Cleveland, O.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting and Mechanical
Dodge & Day, Philadelphia, Pa.
Hollingsworth, Samuel, Plainfield, N. J.
Lewis, F. D., New York.
McGeorge & Sons, Cleveland, O.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.
Dodge & Day, Philadelphia, Pa.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.

Engines, Gas and Gasoline
Backus Water Motor Co. Newark, N. J.
Capital Gas Engine Co., Indianapolis, Ind.
Foos Gas Eng. Co., Springfield, O.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Regal Gasoline Engine Co., Coldwater, Mich.
Struthers-Wells Co., Warren, Pa.
Woolley Fdry. & Mach. Co., Anderson, Ind.

Engines, Oil
International Power Vehicle Co., Stamford, Conn.
Mietz, August, New York.

Engines, Steam
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Garden City Fan Co., Chicago, Ill.
Rand Drill Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Envelope Sealing Machines
Kinsey-Burt Co., New York.

Exhaust Heads
Burt Mfg. Co., Akron, O.
Sturtevant Co., B. F., Boston, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Fans, Electric
Fidelity Electric Co., Lancaster, Pa.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Boston, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Garden City Fan Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Nicholson File Co., Provl., R. I.

Filing Machines
Kinsey-Burt Co., New York.

Filler, Iron
Felton, Sibley & Co., Phila., Pa.
Smith Fdry. Supply Co., J. D., Cleveland, O.

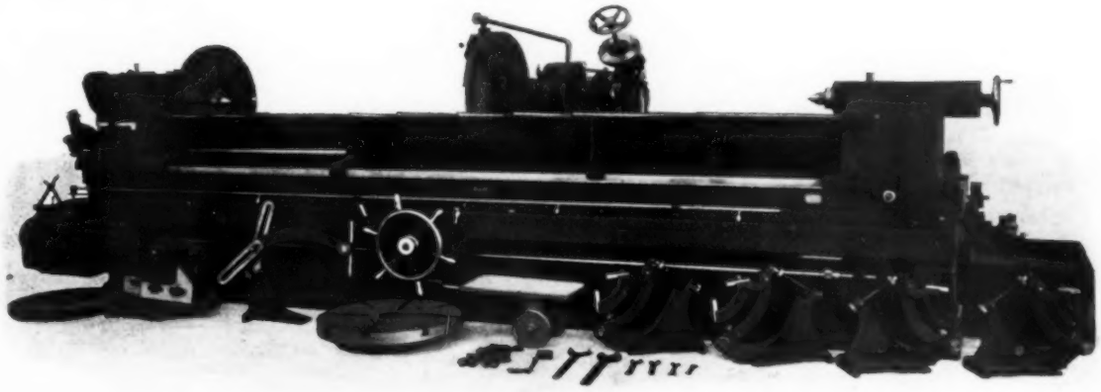
Filters, Oil
Burt Mfg. Co., Akron, O.
Houghton & Co., E. F., Philadelphia, Pa.

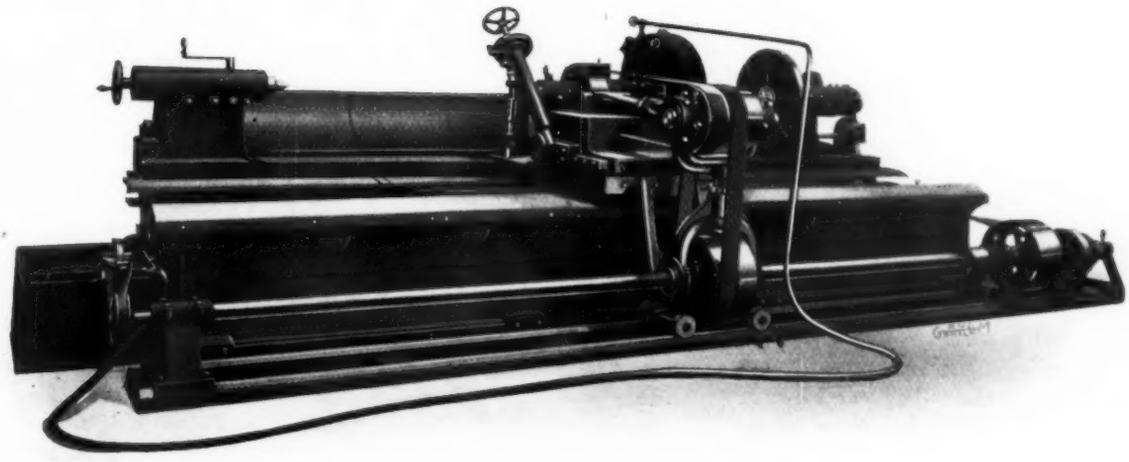
Fire Extinguishers
Badger & Sons Co., E. B., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Boynton & Plummer, Worcester, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Sergeant Drill Co., New York.

The No. 35 Landis Self-Contained Grinder Removes Two Cubic Inches of Metal Per Minute





and it is the most powerful, the heaviest, and the largest grinding machine on the market. With the water guards in position it will swing up to 30 in. and take up to 150 in. and 12,000 lbs. between centers. The diameter of the emery wheel is 30 in., and the machine is equipped with belt or motor drive, as desired. Net weight, 35,000 lbs. For full particulars ask for Special Bulletin.

Landis Tool Company, Waynesboro, Pa., U.S.A.

AGENTS—Walter H. Foster Co., New York, Boston, Cleveland and Pittsburg. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm, St. Petersburg, Liege, Milano, Paris and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Can.

Forges—*Continued*
Macleod & Co., Walter, Cin., O.
Miner & Peck Mfg. Co., New Haven, Conn.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Clapp Mfg. Co., E. D., Auburn, N. Y.
Lang Co., G. R., Cincinnati, O.
Solid Steel Tool & Forge Co., Pittsburg, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Byram & Co., Inc., Detroit, Mich.
Gem Mfg. Co., Pittsburg, Pa.
Obermayer & Co., S., Cincin., O.
Paxson Co., J. W., Phila., Pa.
Smith Fdry. Supply Co., J. D., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Boston, Mass.

Furnaces, Coal and Oil
Rockwell Engineering Co., Jersey City, N. J.

Furnaces, Electric
King, Hugh E., Chicago, Ill.
Pelton & Crane, Detroit, Mich.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Macleod & Co., Walter, Cin., O.
Rockwell Engineering Co., Jersey City, N. J.
Westmacott Co., J. M., Providence, R. I.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
American Steam Gage & Valve Co., Boston, Mass.
Bristol Co., Waterbury, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Meisel Press & Mfg. Co., Boston, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
American Steam Gage & Valve Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bultman & Co., F. H., Cleveland, Ohio.
Clough, R. M., Tolland, Conn.
Dwight Slate Mach. Co., Hartford, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Gear Cutting Machinery *Continued*
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bultman & Co., F. H., Cleveland, Ohio.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Gear Works, Cleve., O.
Cresson Co., Geo. V., Phila., Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Mach. Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Meisel Press & Mfg. Co., Boston, Mass.
Niessmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor, Wilson & Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mch. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor, Wilson & Co., Allehgeny, Pa.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor, Wilson & Co., Allegheny, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer & Co., S., Cincin., O.

Grinders, Center
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Miami Valley Mach. Tool Co., Dayton, O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Bath Grinder Co., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.

Grinders, Cutter—*Continued*
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disk
Bayldon Mach. & Tool Co., Jersey City, N. J.
Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R. I.
Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
Miami Valley Mach. Tool Co., Dayton, O.
Ney, R. W., Pine Plains, N. Y.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Foster Co., Walter H., New York.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Niles-Bement-Pond Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co. Hartford, Ct.

Grinding and Polishing Machines
Bath Grinder Co., Fitchburg, Mass.
Bayldon Mach. & Tool Co., Jersey City, N. J.
Besly & Co., Chas. H., Chicago, Ill.
Blount & Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Provi? dence, R. I.
Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Foster Co., Walter H., New York.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Miami Valley Mach. Tool Co., Dayton, O.
Montgomery & Co., New York.
Ney, R. W., Pine Plains, N. Y.
Niles-Bement-Pond Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Osgood, J. L., Buffalo, N. Y.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck-Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.

Grinding and Polishing Machines—*Continued.*
Walker Co., O. S., Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Houghton & Co., E. F., Philadelphia, Pa.
Millers Falls Co., New York.
Niles-Bement-Pond Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Scranton Whetstone & Abrasive Wheel Co., Scranton, Pa.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Athol Machine Co., Athol, Mass.
Lombard & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hack Saw Blades and Frames
Atkins Co., E. C., Indianapolis, Ind.
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Montgomery & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
Thompson, Son & Co., Henry G., New Haven, Conn.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Atkins Co., E. C., Indianapolis, Ind.
Diamond Drill & Mach. Co., Birdsboro, Pa.
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Fairbanks Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Montgomery & Co., New York.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Thompson, Son & Co., Henry G., New Haven, Conn.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Toledo Mach. & Tool Co., Toledo, Ohio.

Hammers, Electric
Northern Elec. Mfg. Co., Madison, Wis.

Hammers, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Rand Drill Co., New York.

Hammers, Power
Miami Valley Mach. Tool Co., Dayton, O.
Niles-Bement-Pond Co., New York.
Scranton & Co., The, New Haven, Conn.
Sutton Co., C. E., Toledo, O.

A Simple Dynamometer.*

BY W. J. SPIRO.

When a factory or manufacturing plant is located in the city, where ground rent is high, it is necessary that it cover the least practicable area, the necessary amount of floor space being secured by building it two or more stories in hight. This introduces the problem of transmitting the motive power needed to drive the various machines and tools from one floor to another, with the least possible loss and at the lowest possible expense.

There are at present recognized three solutions of this problem. The first and that which has the sanction of long-continued practise and widest use employs a series of line shafts, one for each floor, driven by a system of belts running vertically or diagonally from floor to floor. The friction and other losses in such a system are large, being stated by various writers to be from 25 to 40 per cent. of the power input, the exact percentage of loss depending upon the size of the building, number of floors, variety and condition of the transmission machinery, etc.

The second system is what is known as "electrical drive," and consists in first transforming the power into electrical energy by means of a dynamo, then transmitting it over copper wires to the various parts of the plant, and finally transforming it into mechanical work by means of electric motors attached to the machines to be driven, or to the line shaft.

The third method of power transmission consists of a vertical shaft extending from basement to roof, which is driven by belt from the engine, and from which quarter-turn belts at each floor drive the several line shafts. This system, tho but little known and used, nevertheless possesses many advantages, from the points of view of economy, safety and convenience, and an investigation of its merits, with special reference to the determination of the energy necessary to drive the vertical shaft under all conditions of load, should lead to useful results. It is the object of this paper to present the results of such a test, made on a shaft used in the works of the Columbia Typewriter Manufacturing Company, of 116th street, New York city, and transmitting 50 horse-power to the six stories of the building. A sketch of the plant showing the relative positions of the engine, vertical shaft, line shafts, belts, etc., is shown in Fig. 1.

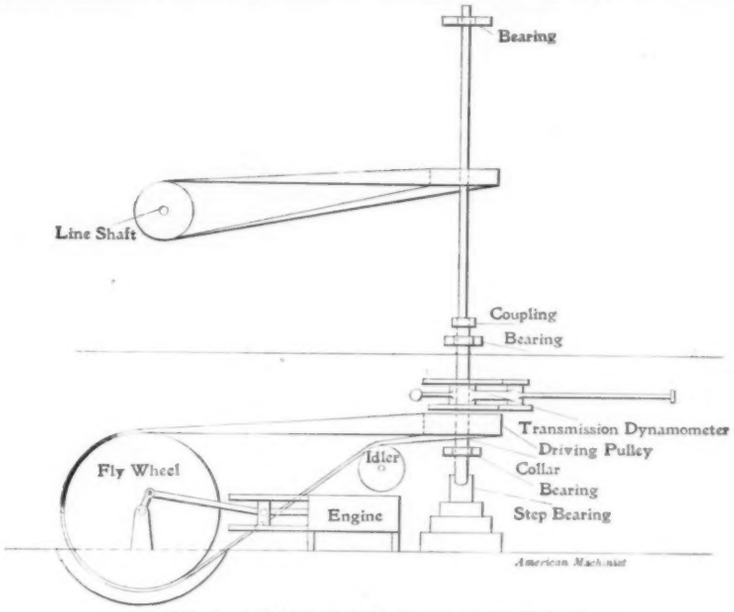


FIG. 1. SKETCH OF THE PLANT TO BE TESTED.

In order to perform this test a special transmission dynamometer was designed and constructed, and was used to measure: (1) the power to drive the vertical shaft alone; (2) the power used up in the quarter-turn belts, and (3) the power necessary to drive the entire transmission system of vertical shaft, line shafts and belts.

The instrument bears some resemblance in principle to the Webber differential dynamometer, but is designed to overcome the various drawbacks of the latter, chief among which is the fact that the driving and the driven shafts must revolve in opposite directions.

The main point in view in designing the instrument used in this test has been to produce an apparatus which would do the work required of it without any way interfering with the operation of the plant to be tested, and without requiring any extensive alterations to the latter. Thus it was necessary that both the engine and the vertical shaft should revolve in their usual directions, since (A) the engine was not susceptible of reversal, and (B) if the motion of the shaft were reversed the quarter-turn belts would run off. Further, no change in the shaft itself or in any of the pulleys or belts would be permitted by the owners. The instrument must be complete in itself, and require no modification of the plant to be tested, other than the loosening of the driving pulley on the vertical shaft. Let us see how these conditions were met in the instrument as designed.

Referring to Fig. 2, *S* is the vertical shaft, normally driven by a pulley (not shown) over which passes a quarter-turn belt from the engine flywheel. For the purpose of the test this pulley was loosened on the shaft and connected by straps to gear *B*, which also revolves loosely on the shaft, and which will hereafter be called the driving gear. *E* is an arm revolving loosely on shaft *S* and carrying at its other extremity the arbor *M* to which are keyed the pinions *C* and *D*. The gear *A*, which meshes with the pinion *C* and will be called the driven gear, is clamped rigidly to the vertical shaft *S*. Into the extremity of the arm *E* is screwed

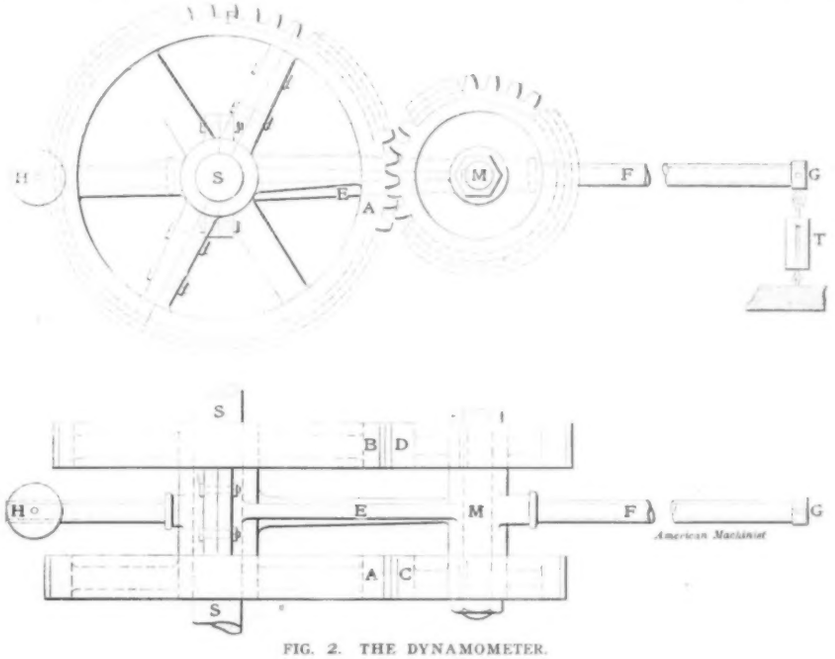


FIG. 2. THE DYNAMOMETER.

* Abstracted from *The School of Mines Quarterly.*

a length of gas pipe *F*, carrying a ring *G*, to which is attached one end of a spring balance *T*, the other end of which is rigidly attached to a beam. The other end of the arm *E* carries a shorter length of pipe, on which slides the leaden ball *H*. This ball may be fastened by a set-screw at any point of the pipe on which it slides, and its purpose is to counterbalance the weight of the arm *E*, the pinions *C* and *D*, and the pipe *F*.

The operation of the dynamometer is as follows: The power of the engine is transmitted by the quarter-turn belt to the driving pulley, and thence to the driving gear *B*. This gear meshes with and drives the pinion *D*, which in turn drives the pinion *C* thru the arbor *M*, to which both are keyed. The pinion *C* drives the gear *A*, which is rigidly connected to the shaft *S*, from which the power is taken off by quarter-turn belts at the various floors.

Now, as long as the arm *E* remains stationary, the engine will drive the vertical shaft positively, thru the train of gears. But let us suppose that so great a load is applied to the shaft *S* as to hold it, together with the gear *A*, immovable, and let us further suppose that the arm *E* is free to revolve about the shaft *S*. Then, owing to the differential action resulting from the difference in size of the gears *A* and *B* and the pinions *C* and *D*, the entire power of the engine will be consumed in rotating the arm *E* about its shaft.

Now, if we assume the normal working conditions—*i. e.*, *S* carrying its normal load and motion of *E* resisted by the action of the spring balance *T*—then it will be evident that the power applied at *B* may be expended in either of two ways: it may rotate the shaft *S*, thus carrying the machinery load, or it may revolve the arm *E* about that shaft against the resistance of the spring balance *T*. Since any force always chooses the path of least resistance, the engine will choose that one of the two alternatives which demands the expenditure of the least amount of power. What will actually happen is this: The rotation of the gear *B* will cause the arm *E* to revolve until the resistance of the spring balance is just equal to the resistance to motion of the shaft *S*. Further revolution of *B* will then cause revolution of *S*, *T* remaining in a position corresponding to the load on *S*. The balance *T* will therefore measure the pull necessary to revolve the shaft *S*, and since we know the effective length of the arm *E* and the number of revolutions of *B* per minute, we may calculate the horse-power input necessary to revolve the shaft together with its load.

Such is the principle of the transmission dynamometer, and it will be seen that its use necessitates no alterations in the plant other than the loosening of the driving pulley on the shaft *S*. Furthermore, this driving pulley will revolve in the same direction and at nearly the same speed as the shaft and will therefore be free from any tendency to heating.

The various parts of the dynamometer having been completed and assembled, the instrument was placed in position on the vertical shaft, the weight of its parts being supported by a collar fixed on the shaft. Arms (not shown in the drawing) extended upward from the gear *B*, engaging with the spokes of the driving pulley, while similar arms extending from gear *A* engaged with the spokes of another pulley, loose on the shaft, to which the band of the prony brake was applied.

The spring balances of the dynamometer and the prony brake having been calibrated by means of weights, and being found sensibly correct, the calibration of the dynamometer itself was next undertaken. For this purpose gear *A* was not clamped to the vertical shaft, but was alowed to revolve loosely thereon, liners being put between its two halves to accomplish this. The band of the prony brake being loose, the engine was then started, whereupon the arm of the dynamometer swung around in the opposite direction to that in which it was expected to turn. It was soon seen that, there being no load on the gear *A*, the friction of the various parts was carrying the entire arm around in the same direction as that in which the driving pulley revolved. The spring balance being removed to the other side of the arm, and the engine being again started and brought up to speed, it was seen that the friction produced a practically constant pull of 10.1 pounds on the balance at a radius of 2 feet 3.36 inches, corresponding to pulls of 6.72 pounds and 3.36 pounds at radii of 3 feet 5.1 inches and 6 feet 10.2 inches, respectively. If we regard pulls in this direction as negative, then it is evident that we must subtract from the scale readings at any load the constant friction pull above determined, in order to obtain the actual pull due to the load.

Proceeding thus, the prony brake was now put into service, and simultaneous readings taken of the brake and dynamometer scales. From a comparison of these readings it was found that the friction loss in the dynamometer increased slightly with increase of load. After a load of about 20 horse-power was reached it was found impossible to proceed with the prony brake, owing to the lack of provision for cooling the latter.

The dynamometer having been calibrated, a test of the power consumed by the vertical shaft at various loads was next in order. For this purpose the gear *A* was clamped tight to the vertical shaft, as was also the pulley on which worked the prony brake. Load was now applied to the latter, and was transmitted thru the vertical shaft to the dynamometer, where it was measured. The readings and results are given in Table 1 and show that the loss in the shaft is nearly constant at all loads, and amounts to only about 1¼ horse-power.

A Prony-Brake Pull.	*B* Load in H.P.	*C* Dynamometer Pull.	*D* Corresponding Pull at no Load.	*E* Dynamometer Pull due to Load.	*F* H.P. Required to Turn Shaft.
0	0	— 8.3	— 10.1	1.8	1.224
15	3.4	— 3.25	— 5.1	1.85	1.258
30	6.8	1.6	— .2	1.8	1.224
45	10.2	6.55	4.75	1.8	1.224
60	13.6	11.6	9.75	1.85	1.258
75	17	16.4	14.5	1.9	1.292
90	20.4	21.4	19.55	1.85	1.258

TABLE 1.
TEST OF POWER REQUIRED TO DRIVE VERTICAL SHAFT AT VARIOUS LOADS.

Run No.	*A* Increment of Load.	*B* Dynamometer Pull.	*C* Corrected Pull.	*D* Increase of Pull.	*E* H. P. Input.
1	Vertical shaft.	— 8.3	1.8	1.8	1.224
2	Basement belts and shaft.	— 6.9	3.2	1.4	.952
3	1 Floor " " "	— 5.8	4.3	1.1	.748
4	2 " " " "	— 3.1	7.05	2.75	1.87
5	3 " " " "	— 1.4	8.76	1.71	1.163
6	4 " " " "	1.1	11.31	2.55	1.734
7	5 " " " "	2.1	12.33	1.02	.694
8	Entire shaft load.	2.1	12.33	. .	8.384
9	Full working load.	17 4	20.76	. .	42.35

TABLE 2.
TEST OF POWER REQUIRED TO DRIVE VARIOUS PARTS OF TRANSMISSIVE MACHINERY.

The next and last part of the test consisted in ascertaining the power required to drive the belts and shafting forming the power-transmission system of the factory. The prony brake was removed, and the quarter-turn belts at the various floors were put on one by one, the load due to each belt and line shaft being measured at the dynamometer. Table 2, which gives the result of this test, shows that the power required to drive the transmissive machinery constitutes only about 20 per cent. of the total power consumption, proving that the vertical-shaft transmission involves a saving in power of from 5 to 20 per cent. over the common belt transmission.

It was desired that all tests be made at the normal speed of revolution of the shaft, and since the interposition of the dynamometer reduces the shaft to 23-26 of the speed of the driving pulley, it was necessary to speed up the engine so as to make the driving pulley revolve 204 times per minute in order that the vertical shaft might make its normal 180 revolutions per minute. The speed during the entire test was kept constant by the engine governor, tho this was checked at frequent intervals by the use of revolution counters.

It was found that, especially at high loads, the fluctuation of the dynamometer scale was considerable, tho this could be greatly reduced by a proper adjustment of the balancing arm *H*. In future use of the instrument it might be well to attach a dash-pot in order to overcome this fluctuation. It would also be desirable to replace the 1-inch pipe *F* by a solid rod, which would obviate the possibility of breaking at the thread.

This transmission dynamometer should prove useful in making tests on various types of machine tools to determine accurately their power consumption, as well as to find the losses in transmission systems, the relative efficiencies of rope and belt drives, etc. The fact that it can be operated on a line shaft without change or injury to the latter should make it useful for making tests in factories up to the limit of its capacity (about 100 horsepower). In fact, it is hoped that this test of a vertical shaft will prove but the introduction to a wider field of endeavor in which the transmission dynamometer herein described shall play an important and useful part.

There are two entirely different systems of designating the sizes of wire screens or woven-wire cloth. In the more open sizes of heavier wire as used in mining, quarrying, gravel pits, etc., the actual size of the opening is stated, as ¼", ⅜", etc., but in all other wire cloth the distance from center to center of wires is measured and the number of these distances to the inch is stated. Thus five mesh, or five to the inch, would not mean that the opening was one-fifth of an inch, but one-fifth of an inch less one diameter of the wire, the opening varying with size of wire.

Dimensions on Drawings.

BY FRANK B. KLEINHANS.

No mechanic can be expected to work to advantage from drawings which are poorly dimensioned. Take, for instance, a person working on a Jones & Lamson turret lathe. In many shops these men are not trained machinists and consequently one could not expect them to read complicated drawings without considerable study. These men frequently have to work from drawings which have the dimensions given as shown in Fig. 1. This stud is to be made from cold-rolled steel. In order to take the first cut which reduces the bar to one inch from the end to the shoulder, the worker must add together the various dimensions. When sixteenths and sixty-fourths are frequent, this is no easy task even for a checker, let alone one who is unaccustomed to this class of work. It will be noticed that the detail figures are arranged in one straight line, which makes it impossible to determine the figures from one off set to another without adding several figures.

Fig. 2 shows this same stud figured in accordance with the pieces which this stud is to fit. One line of dimensions locates the principal shoulders while the other dimensions are located one way or other from these. The advantage of dimensioning the drawings this way is that the errors—and there always is some error—will not constantly accumulate on a half a dozen dimensions. Thus, if one chose to place on the end of the stud an extra 1-16 or ⅛ inch, no harm would be done; or, if one chose to use a different thread clearance from that shown on the drawing, the dimensions would keep him from doing anything harmful.

In placing dimensions on drawings for castings which are required to be machined, it is important first to give the planing dimensions. There is nothing more exasperating to a lathe hand or foreman than to be compelled to stop a machine and figure out the location of a tongue upon which he must depend to line up parts of the machine.

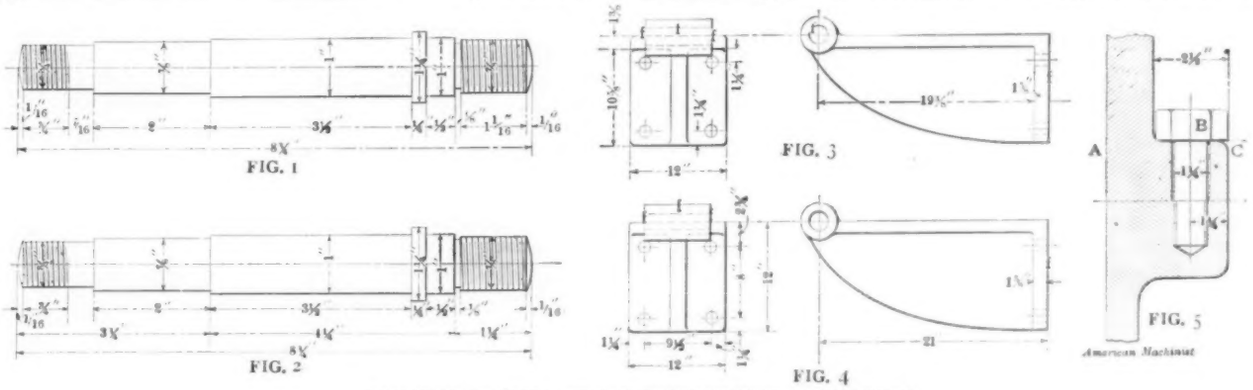
In this connection it might be mentioned that there are two general methods of making drawings. In the first case, the tracer is given the pencil drawing without any dimensions having been placed on it. He must trace this drawing and put on the necessary dimensions. In the second case the draftsman places the figures on the drawing himself. In the latter case the draftsman is familiar with the drawing and understands the method of machining, etc., and thus invariably places his figures to much better advantage.

In placing dimensions on drawings, one should give first the dimensions that are necessary to plane the piece, locating the less important parts from the main planing. After this the dimensions should be arranged for boring and turning, drilling, etc., in each case from some principal plain surface or some center line.

Fig. 3 shows an arrangement of dimensions which is frequently found on drawings. These figures are all correct as far as checking is concerned, but it is impossible to do any machine work on this casting and fit it to another without going thru the process of adding and subtracting.

An arrangement of dimensions which obviates all this trouble is shown in Fig. 4, besides making it easier to check up the drawing before it goes into the shop. Fig. 5 gives an example of a very common source of trouble in the erecting shop. The bolt *B* is 1¼ inches in diameter. The casting has a large fillet of at least ¾ inch radius at *A* and a round corner of at least ½ inch radius at *C*. Ninety-nine times out of a hundred the head of the bolt will project over the edge of the flange or else a lot of chipping will have to be done to get rid of the fillet at *A*. On a large casting like this, a flange should be made at least 3 inches wide and the bolt be placed 1⅜ inches from the outer edge. This would make a much neater job and would cause no trouble.

One of the reasons which is probably responsible for more unuseful dimensions than any other is the fact that too many dimensions are given. Drawings are often to be seen which are so full of figures that they would make one dizzy trying to find the desired dimension. The constant trend in placing dimensions on drawings is never to repeat dimensions on any of the views. If this was strictly carried out and good, sound judgment used in selecting proper dimensions, little trouble would be experienced in the shop.



EXAMPLES OF GOOD AND BAD DIMENSIONING OF DRAWINGS.

A New Sand-Blast Apparatus.

BY FRANCIS STICKER.

Air, water and steam are the mediums at our disposal for the working of the sand-blast machine, each of which gives the sand special, singular properties which must be considered in the construction as well as in the use of the machine. Sand-blast machines use compressed air to give the sand certain desired qualities. It is a well-known fact that all compressed gases develop a very high velocity while escaping from a closed vessel. In previous machines the velocity of this escaping gas, as air, for instance, has been utilized to give a mixture of sand and air the highest possible velocity to perform certain work, as cutting, cleaning, etc. Undoubtedly, the velocity of a given mass is able to remove resistances, such as scale or rust on iron, dirt on stone buildings or paint on iron fences; but proper mixing of the sand and air is the most important consideration, and not the velocity of the air.

The theory and practise of jet apparatus in general, and the steam injector in particular, clearly outline the way to build a perfect jet apparatus for air and sand, or for any other mixture where thorough mingling and velocity are to be created. In steam injectors, the steam is utilized only to create a suction to elevate the water; but after this has been accomplished every conceivable means are adopted to harness this velocity and transform it to more useful purposes; that is, power, first, to give the water and steam time for mixing, then to allow this mixture to attain the necessary power to overcome any friction in pipes or valves and the overpressure of the boiler. For example, steam entering an injector with a velocity of 1,900 feet per second, at a pressure of 120 pounds, leaves it with only a fraction of its original velocity after being properly mixed with water; and even after imparting the necessary motion to the inert water it attains an end pressure far exceeding its initial one, so that actually a boiler having only 100 pounds pressure, in connection with an injector, can easily feed another boiler carrying 130 pounds or more pressure.

The foregoing clearly outlines the manner of construction of any jet apparatus, especially a sand blast, and therefore the apparatus to be described will be readily understood.

The design shows a tank or casing supported by several legs; but it can be suspended just as well. The tank is made with a small hand-hole for the examination of the inside, or to make any repairs necessary. On top of the tank is an opening for filling it with sand, which opening is closed by a screw plug after the tank has been filled. In the center of the top of the tank is a small casing forming a chamber. A pipe closed at the upper end is threaded in the top of this casing, and carries a handle on its outer free end. The pipe can be moved up or down by turning the handle to the right or left, and extends to the bottom of the tank. Near its upper end at a point within the chamber the pipe is provided with one or more small apertures which allow communication between the inside of the pipe and the chamber. At a point within the tank additional apertures afford communication between the pipe and tank. On the lower end of the pipe is screwed a cup-shaped valve which fits into an opening in the bottom of the tank, and by raising or lowering the pipe by means of the handle the valve opens or closes the sand reservoir and regulates the outlet for the sand. At the bottom of this valve is a jet-formed nozzle which affords communication between the pipe, the valve and the outside of the tank. As will be seen later, this mechanism admits air into the upper portion of the tank and thru the pipe to the lower outlet of the tank, and at the same time regulates the outlet of sand.

A knee-shaped casting called the mixing chamber, and entirely new in sand-blast machines, extends downward from the lower part of the tank. The nozzle of the sand regulating valve extends vertically into this mixing chamber, and controls communication between the tank or sand reservoir, and the mixing chamber. Further pipe connections on the outside of the mixing chamber indicate two other inlets, one on the bend of the knee extending vertically; another below extending horizontally in line with the outlet to a flexible rubber hose attached to the mixing chamber. Their use and purpose will be shown later on. The end of the hose is supplied with a nozzle to direct the mixture of sand and air wherever desired.

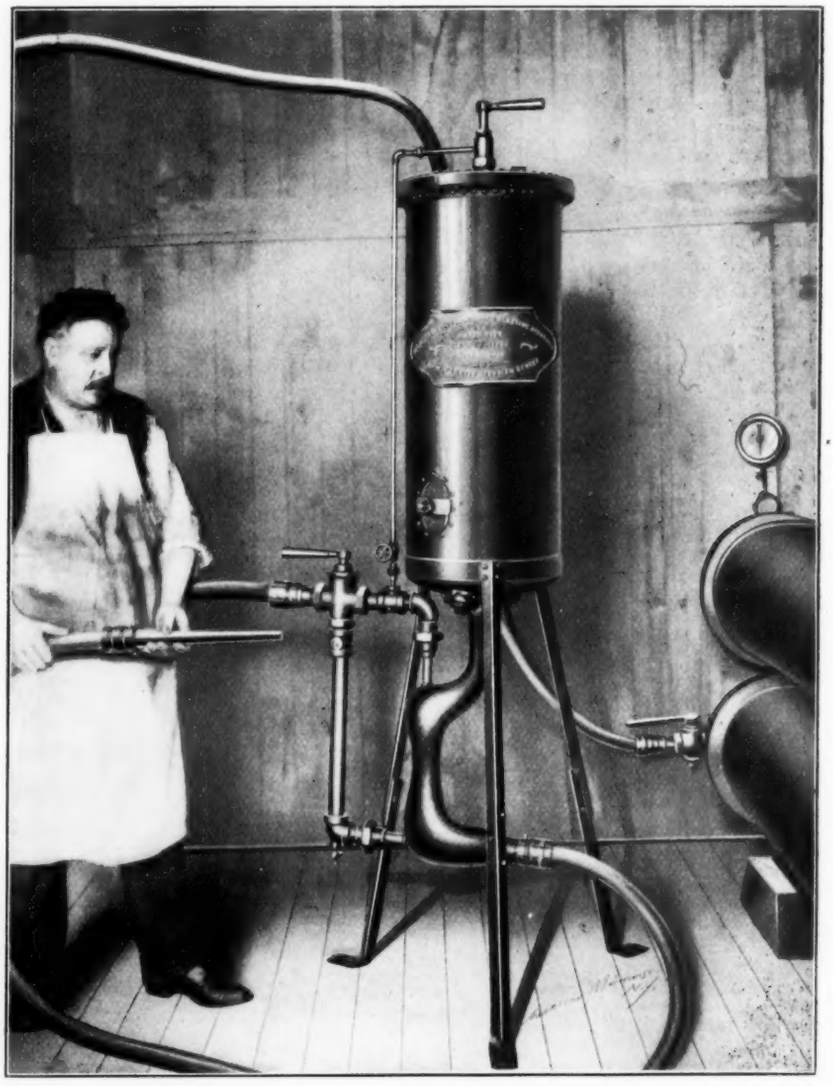


FIG. 1. THE STICKER SAND BLAST.

Below and to the left of the tank or casing is shown, in Fig. 1, a cock controlling communication between all the outside pipe connections and the tank and mixing chamber. This cock admits and regulates the air supply. The construction of the cock is such that by its movement the operator can either admit air consecutively to the sand reservoir, the pipe, the different nozzle connections on the mixing chamber, or simultaneously to all of them. The cock is connected to a reservoir which furnishes the motive power.

Compressed air is admitted to the air admission cock or valve by means of a rubber hose, or by any other means of communication, especially if the plant is stationary. As described previously, three different and distinct pipe connections, lead from this air admission cock. One small pipe extends to the top of the tank or sand reservoir into the chamber thereon which it communicates with the interior pipe. Another pipe affords communication with the upper vertical part of the mixing chamber, and the third with the lower horizontal part of the mixing chamber. The sectional view of the air admission cock shows its construction.

The tank having been filled with the quality of sand decided upon for the special work in hand, and closed tightly by means of the filling plug, the operator admits compressed air to the machine by means of the air admission valve. The first slight turning of the cock admits air to the sand reservoir, the sand regulating valve being closed. The air will enter thru the upper apertures in the pipe and partly escape thru those slightly above the normal level of the sand, and exert a slight pressure on the sand itself, on account of the holes being very small and the air flow not being confined to the inner part of the sand reservoir, as the escaping air finds another outlet down thru the sand regulating nozzle into the mixing chamber, and from there thru the rubber hose and nozzle into the atmosphere. A further slight movement of the sand regulating valve opens communication between the sand reservoir and the mixing chamber. The cup-shaped valve, giving a wide area for the outlet of the sand, distributes it over a wide surface and makes it run more easily than when forced thru a small opening where there might be danger of clogging, as sand when wet has a tendency to do. The gravity of the sand, in connection with the slight pressure on top of the same, and the suction created thru the bottom nozzle, forces the sand thru the sand regulating valve, and into the cup-shaped nozzle, spreading the sand into a fan-shaped cloud and bringing it into contact with the air escaping thru the valve. The cup-shaped valve tapers down as it extends into the mixing chamber to a gradually contracting area or neck, so that the sand coming out in the form of a cloud is again gradually contracted and brought into close contact with the issuing air. The sand and air being mixed together by this process then pass thru the narrow neck into a gradually widening opening, where the mixture again has a chance to escape and form a cloud, and by this time, the operator having opened the air cock further, air enters the upper vertical portion of the mixing chamber, meets the cloud mixture and carries the same down to a slowly narrowing passage again, where there is a slight compression, and consequently a further mixing of the air and sand takes place besides bringing the mixture directly into the line of air discharged into the vertical part of the mixing chamber. Passing out of the narrow passage, the mixture is driven into the lower bell-shaped portion of the mixing chamber, and the air cock having been now fully opened, admits the compressed air to the lower horizontal portion of the mixing chamber, where the air meets the mixture and forces it out of the tapered end of the mixing chamber into the rubber hose and thru the nozzle fastened thereon, into the atmosphere.

It will readily be seen that the repeated expansion and contraction of the sand and air by means of the peculiar construction of the mixing chamber has a tendency to

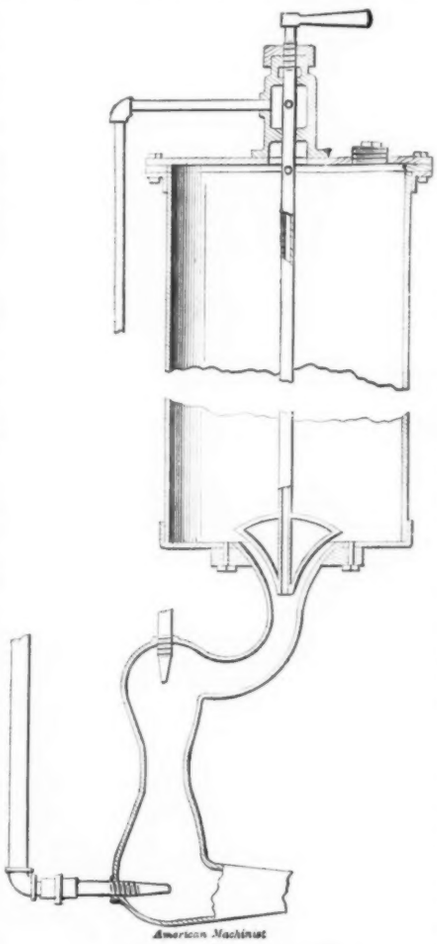


FIG. 2. SECTION OF SAND BLAST.

retard the flow of the air and reduce its velocity, which gives it sufficient time to mix with the sand, so that when finally air and sand leave the end nozzle, we have a thoroughly mixed sand blast whose force lies not in the velocity of the air, but in the absolute density of the volume of air and sand, and the result is a highly efficient and economical sand blast. Not a particle of air or a grain of sand is wasted in the use of the apparatus. This construction not only improves the working of the machine, but it requires the minimum amount of repairs. In the Sticker apparatus the couplings, bore and nozzles last almost indefinitely, for the reason that the diminished velocity reduces the wear and tear to a minimum.

The construction as well as the dimensions of the nozzle are of course of the highest importance. The construction must follow the laws of the flow of air under different pressures, and the sizes must gradually increase from the upper or first nozzle down to the last one. An increasing impetus must be given the jet to make it efficient, as well as to avoid any forcing back into the sand reservoir itself; for it must be understood that the outlet nozzle on the end of the rubber hose is considerably smaller than the combined areas of the other nozzles used in the machine. It has been found by actual practise that the amount of air requisite to make the blast powerful is very small when adopting thi principle, and that the air compressor may be correspondingly small.

The nozzles, especially the one at the end of the rubber hose, are all made of the best tool steel, reamed and finished to the proper size and shape, and not from gas pipe, which wears out in a very short time. A properly formed nozzle lasts almost indefinitely under the conditions mentioned.

Among the details of this machine, the hose coupling shown in Fig. 3, specially designed for it, deserves attention. It is of the highest importance to give the jet a regular, even flow, avoiding all sharp corners or edges, and this is accomplished in this hose coupling. As the illustration shows, the hose is slipped over a tapered portion of the main part of the coupling, a tapered ring is put around this, and a nut is screwed on which brings the ring forward and presses it together around the rubber hose without injury to it, and at the same time making a reliable and tight joint able to withstand any pressure. There are no sharp edges, and the flow of sand and air is absolutely unhindered, while the area of the hose, as well as the nozzle next to it, is identically the same.

The air admission cock, also shown in Fig. 3, contains a new feature. It is well known by users of steam, air or water cocks that they have a tendency to stick. It will be seen that in this cock the upper portion of the plug is provided with a shoulder, and that by means of the stuffing-box construction it is possible to slightly loosen the cock should occasion demand it.

The air pressure required depends entirely upon the class of work to be sand-blasted. Glass and soft material need very little pressure, and the same is true for cleaning castings and the fronts of stone houses, while steel plates, pipes, granite, etc., require greater pressure. But in most cases it will be found that it is more the selection of the proper kind of sand than great pressure which makes the machine efficient. Sand can be obtained in many varieties, natural and artificial; but care must be taken to have it uniform. The

sand should have sharp cutting edges, and this is seldom found in beach sand, where the continual rolling rounds off the corners.

A great advantage of this machine is the fact that the sand, if a little moist, will not clog, the construction in itself keeping the sand and air in constant motion, primarily because of the suction created at the bottom of the tank, since, if the only pressure were that upon the top of the sand the strongest air blast would not force sand from the tank.

Different nozzles are used for different classes of work. While in one instance it might be advantageous to have a small, powerful jet, in another it might be better to have a large spray to cover more space in a shorter time.

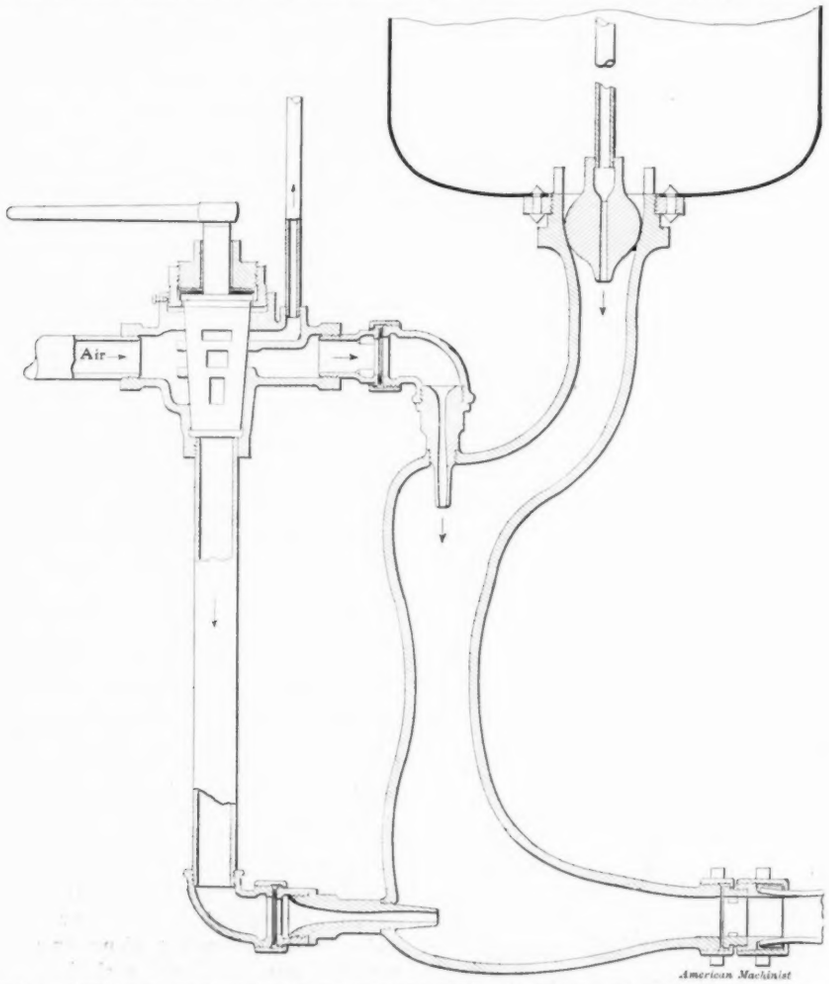


FIG. 3. SECTION OF MIXING CHAMBER NOZZLES, HOSE COUPLING AND REGULATING COCK.

69 Beekman street, New York.

The latest name for a Cleveland Oil Company which is unfortunate in its shipments of small lots of oil is the Bolton Oil Company, which writes to a friend of ours saying that it has a half barrel of a certain kind of oil which was "shipped by mistake" and it is offered at what is evidently intended to be taken at a low price. It is of course the old game under a new name. Its continued vitality is hard to understand.

Alcohol for Motors—I.

BY M. C. KRARUP.

Whether alcohol will eventually supersede the hydro-carbons derived from petroleum as a fuel for internal-combustion engines and oil-fired steam plants, is a question which is finally forcing itself upon the attention of American users of power, despite the fact that alcohol is not at present obtainable in this country at a price that would make its use anywhere nearly as economical as that of kerosene or even gasoline.

The reports which have come from Germany and France during the past five years have told of a rapidly widening practical use of alcohol in stationary explosion engines, of an increasing measure of success in its employment for traction engines and locomotives, and of the great interest of the two governments in its substitution for petroleum products, resulting in public competitive tests for motors, automobiles and motor boats operated with alcohol. A number of well-known automobile manufacturers, mainly in France, have made it a point to demonstrate that their cars may be operated with alcohol just as well as with gasoline. René de Knyff, of the Panhard et Levassor firm, has used alcohol in every great race for several years; the Gobron-Brillié, the Decauville, the Georges Richard-Brasier and a considerable number of other cars are fitted with carburettors designed for optional use of the two fuels, and while it is true that it is usually a half-and-half mixture of 90-degree alcohol and crude benzine that is employed in these automobiles, the preference for this mixture is understood to be due to commercial rather than technical reasons—n ainly the price and a certain assurance of getting fuel of uniform composition. The greater facility in starting the cold motor with the more volatile benzol-alcohol has, however, undoubtedly also something to do with the matter, and, as shown later, it is highly improbable that automobile motors designed exclusively for alcohol without admixture would not give higher efficiency if differing in some respects from those designed for gasoline. or optional use of gasoline or carburetted alcohol.

In stationary motors and motors employed industrially for hauling loads under a time schedule an instantaneous start is of course not so important as in automobiles.

For several years it has been believed here that the principal reason for the efforts made in Europe lay in the opposition of the powerful agrarian parties in the politics of both Germany and France against an imported product, the supply of which might be cut off in case of war, or the price of which might be indefinitely ra.sed, and this supposition, which was not far from the truth in the beginning of the alcohol movement and still holds good within certain limits, created the impression in America that the technical advantages claimed abroad for alcohol were more or less fictitious, and that there was little reason for us, living in the principal petroleum-producing country, to occupy ourselves with the sifting of fact and fiction in this particular branch of engineering. True, the petroleum production here was and is in the hands of one corporation which plays fast and loose with prices and qualities as it chooses, which has practically ordered the motor industry to adapt its product to a low grade of stove gasoline under threat of getting no other kind, and which prefers to sell the bulk of its high-grade articles in Europe (where the Russian competition is to be reckoned with). The reasoning usually ran abo t as follows: There might be some sense in getting away from the yoke of the petroleum monopoly, if possible; but was it possible? Besides, there was the government tax of $1.10 cents per proof gallon of grain alcohol, which brought a revenue of $115,000,000 each year, a regular and needed revenue which there was little chance of getting replaced from any other source, especially after an income tax had been declared unconstitutional, and, anyway, this tax was thoroughly in accord with the popular demand that taxes should be levied on lux-

uries. If ever there was a luxury, alcohol was one. Altogether, cheap alcohol seemed a remote possibility, certainly not worthy of much thought so long as it seemed pretty certain that it could never quite equal gasoline and kerosene as a fuel and source of power. It contained only half as many heat units, roughly speaking, and since it is the heat unit that must be transformed into power, it seemed evident that the price of alcohol would have to be about one-half of that of gasoline before there could be a question of competition; in fact, it would have to be half that of kerosene, as otherwise all the efforts to be expended to get alcohol under control had better be devoted to kerosene.

Such has been the attitude generally taken in this country in regard to alcohol as a fuel for internal combustion engines; and, as to its use under steam boilers or as an illuminant, it has not even been considered in the most casual manner. And a similar apathy due to similar causes has been echoed back from England, with the only difference that the scientific interest in the Continental experiments and their practical results has always had British representatives who kept their fingers on the pulse of progress and were able to signal their industrial home public the moment it had been technically demonstrated elsewhere—particularly in Germany—that alcohol really had intrinsic merits as a power source.

The demonstration has been made, and the British are beginning to ask whether it threatens those who disregard it with defeat in the international battle of industry and commerce. The material of the demonstration is accessible to us, as well, being laid down in various publications, and yet it cannot be said that it is the mass of technical evidence relating to the use of alcohol for motor purposes which has finally aroused American interest in the whole question. It is not really the power-plant makers nor the power users in this country who are anxious to find out what they have missed—if anything—or who want to impress the public and the legislators with the advisability of cheapening the new fuel by removal of the tax. On the contrary, they are being besought to interest themselves in their own presumable welfare, and those who beseech them are the appointed representatives of a number of industries in which cheap alcohol is needed for purposes that have absolutely nothing to do with power and fuel. These industries want the motor and automobile industries and all power consumers who patronize these industries to be their allies in a great political, and perhaps sociological, fight for cheap, tax-free alcohol which is to be waged during the next few years and which is destined to become a matter of the greatest interest to the nation at large and perhaps a bitterly contended political issue.

And it is understood that the industries and interests grouped around the manufacture and use of stationary as well as portable and portative engines (and chiefly those of the internal-combustion type) must first be convinced of the technical merit of alcohol as fuel, including its economy under conditions of equality in taxation, before they may be induced to join the propaganda for tax-free alcohol for industrial purposes in general, and lend to it the powerful aid of forces more strongly and intimately identified with the people's economical life and social pleasures than any of those to which the initiative in the incipient agitation is due.

Neither the alcohol-distilling industry as such nor the agricultural producers of corn, rye, beets and potatoes are as yet among the leaders in demanding tax-free alcohol, and the motor industry is by no means the first to fall in line. Neither is there here an overproduction of alcohol to be disposed of. So the complexion of the alcohol question is already radically different here from what it was in Germany and France. I shall try in a subsequent article to outline the factors which are naturally or by organization arrayed for or against tax-free alcohol, so as to assist in forming an idea as to the chances of the battle, but at present the interest is centered in examining the showing made in Germany and France, from which we, who are most interested in motors and machinery, automobiles and locomotion in general, are expected to make up our minds as to what *we* can accomplish with tax-free alcohol after we get it.

Something which looks like a flaw in the pro-alcoholic argument of European writers on the subject should perhaps be referred to first.

The price at which alcohol may be produced and sold is of course of momentous importance when comparing its economical efficiency with that of the petroleum or coal products—kerosene, gasoline, benzine and benzol. Now, to assume, as has been universally done, that the present price of the petroleum products represents their cost of production and distribution as fairly as the lowest selling price of alcohol represents its corresponding cost of production and distribution, seems to me unwarranted, since it is notorious that kerosene and gasoline were sold ten years ago at about one-half their present prices, and the cost of their production has certainly not been higher these ten years than it was before. I see to my astonishment that *The Engineer*, of London, in an editorial article April 15, 1904, distinguishes with relation to this merchandise between artificial manipulations of the market and the fluctuations due to the "law of supply and demand," considering the latter as natural, unavoidable and justifiable. In other words, tho it may be admitted that kerosene could be retailed at a fair profit for 5 cents per gallon and gasoline for 8 or 10 cents, yet, because the producers by controlling and limiting the supply are able to extort three times as much from the public, this trebled figure is the one to be compared with the natural, open-competitive price of alcohol. To me it seems self-evident that it is within the power of the petroleum interests to throttle any competition from alcohol, in which present petroleum prices constitute a vital factor, whenever they shall deem it desirable to do so, by simply cutting the price of petroleum products in two; unless the manufacture of alcohol may be so simplified as to provide for meeting the reduction.

To leave this contingency out of consideration at the present juncture when there is question of the economical efficiency and technical suitability of alcohol at a given price, is to invite the apathy of the practical-minded to the alcohol movement (so far as alcohol as a fuel and illuminant is concerned), as it is hardly to be expected that business men will engage in the production of alcohol solely for the philanthropic purpose of lowering the price of gasoline, or with no better final result in view than to be bought out by the petroleum interests at the latter's own figure, as soon as the propitious moment shall have arrived when it might be deemed practicable to nip any subsequent alcohol competition in the bud and monopolize the industry already established.

Neither can it be expected that engine builders will spend years in designing engines specially for alcohol merely to have them laid aside as uneconomical the moment the Standard Oil Company and its Russian trade ally decide to make gasoline cheap and perhaps abundant.

Two questions are here of supreme importance to the engine builder and user. One is: Are the modifications of the gas engine which render it fit for the use of alcohol as fuel, in the nature of a special development, tending toward a new type of engine, or are they in the nature of improvements which, while indispensable for the use of alcohol fuel, also raise the efficiency and general value of the engine for use with other fuels, especially gasoline and kerosene; and is it improbable that the gasoline engine and kerosene engine can be improved in any manner not equally applicable to alcohol engines? If this question must be answered in favor of unity of final design, engine builders and users may evidently join the alcohol movement with all their vim, confident that their products will always remain in demand and that their special efforts will be rewarded, whether they result in the victory of alcohol or in the reduction of the price of petroleum products.

The other question is: Does alcohol possess merits apart from economy, which will give it a place in the power world, even if the alcohol engine must be of special design and if its economy should ultimately prove inferior to that of the gasoline or kerosene engine? Analogies are

presented in the steam engine and the storage battery, which are preferred as power sources for certain uses, tho admittedly less economical than the gas engine.

In close connection herewith some determination will be desirable in regard to what tax-free alcohol would cost to produce in this country if distilleries were established with especial reference to the availability of cheap corn or cheap potatoes. And to the political economist, the voter, the politician, the legislator and the executives of administration, the momentous question arises as to whether the industrial and agricultural development of this country requires more abundant liquid fuel than can be obtained from the petroleum wells, and whether it will be necessary to foster the production of a competing fluid in order to limit the further soaring of petroleum prices and bring about a stability of the economical conditions upon which such industrial development depends. This last question is essentially the one which arose first in Europe.

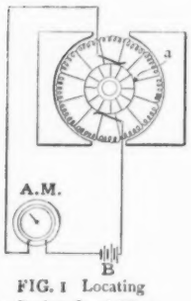


FIG. 1 Locating a Broken Lead Wire

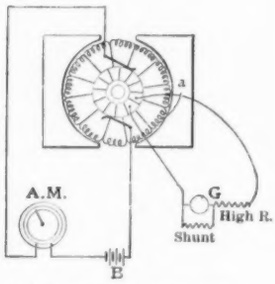


FIG. 2 Locating a Broken Coil

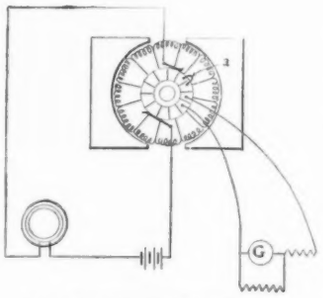


FIG. 3 Locating a Short Circuit between Segments or in Coil

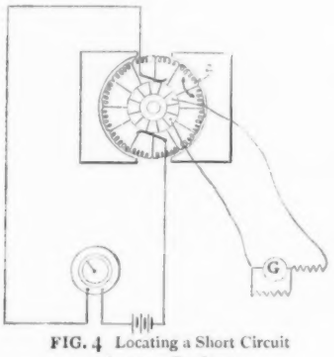


FIG. 4 Locating a Short Circuit between Sections

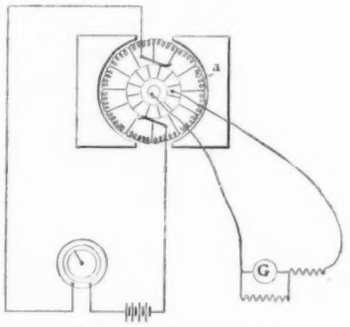


FIG. 5 Locating a Ground

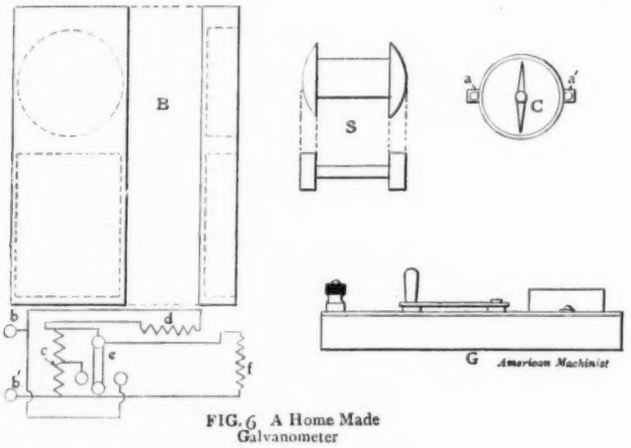


FIG. 6 A Home Made Galvanometer

Locating Dynamo and Motor Faults.

BY NORMAN G. MEADE.

Successful "trouble hunting" in dynamo-electric machinery requires considerable skill and a comprehensive knowledge of the principles involved in its design, and it is the purpose of this article to explain briefly some of the defects that are likely to be found in such machinery, and to give a simple and reliable method of finding them. For the sake of simplicity, the accompanying diagrams illustrate bi-polar machines only, but the elements of the design of bi-polar machines are equally applicable to the multi-polar type.

Most troubles in dynamo-electric machinery arise within the armature. The methods of testing for open circuit, short circuit and ground will now be taken up.

Fig. 1 shows a means of locating a broken lead-wire as at *a*. Clean the brushes and commutator, then apply current from some outside source, say a few cells of battery or a low-pressure dynamo, thru an ammeter, as shown in the diagram. Note the current indicated by the ammeter, rotate the armature slowly by hand, and, if the break is in the lead, the flow of current will stop when one brush bears on the segment at fault. The brushes must not cover more than one segment at one time.

If on rotating the armature once around the deflection of the ammeter does not indicate a broken lead, then touch the terminals of a galvanometer, as in Fig. 2, to adjacent bars, working from bar to bar. The deflection between any two bars should be substantially the same in a perfect armature. If the deflection rises suddenly between two bars, it is indicative of high resistance or a break in the coil, as at *a*.

When two adjacent bars are in contact as at *a*, or a coil between two segments becomes short-circuited, as shown in Fig. 3, the bar-to-bar test with galvanometer will detect the fault by showing no deflection. If there is a short-circuit between two coils, the galvanometer terminals should include or straddle three commutator bars. The normal deflection will then be twice that indicated between two segments until the coils at fault are reached, when the deflection will drop. When this happens, test each coil for trouble; and if individually they are all right, the difficulty is between the two, as shown in Fig. 4 at *a*.

A test for ground is given in Fig. 5. Place one terminal of the galvanometer on the shaft or frame of the machine and the other terminal on the commutator. The batteries and instruments used in the test must be thoroughly insulated from ground. If, under these circumstances, there is any deflection of the galvanometer, it indicates the presence of ground or contact between the armature conductors and the frame of the machine, as at *a*. Move the terminals about the commutator to the point of least deflection, at or near which will be found the contact in the coil connected between two segments showing equal deflection, unless it happens to be close to one segment, in which case there will be a zero deflection.

Grounds in the field coils can be located by the same method.

The shunt across the galvanometer, and the resistance in series with it, enables the operator to make adjustments whereby the instrument can be used for both high and low resistance tests.

Fig. 6 shows the details of a "home-made" galvanometer with shunt and resistance. An ordinary compass *C*, with ears *a* and *a'* bored for screws, is attached to a hardwood block *B*. This block is cut out on the under side, as indicated by the dotted lines. A spool of wood *S*, wound with magnet wire to about 20 ohms re-

sistance, is placed in the circular recess under the compass. Two pieces of wood, wound with about 50 ohms each of magnet wire, are placed in the rectangular recess in the block, which is filled with melted paraffine or wax. Mount a three-point switch on the block and provide two binding posts. The finished instrument will appear as at *G*. The connections of the galvanometer are shown at the left of the figure. The binding posts are represented at *b* and *b'*; *c* is the shunt which has a tap at its center; *d* is the resistance coil, and *f* is the galvanometer coil. The three-point switch enables the operator to cut out one-half of the shunt or the whole of the resistance coil.

A combination testing set, consisting of a Wheatstone bridge, chloride-of-silver batteries and a galvanometer, mounted in a case, is a convenient instrument; but as it is expensive, the ammeter and galvanometer have to be substituted in many cases.

Electric Drive for Fire Pumps.

The importance of instantly operative fire extinguishing apparatus can scarcely be exaggerated. The largest conflagrations are but little flames at the beginning, and if caught at the critical moment they make no record of destruction. The proprietors of large establishments generally appreciate this and provide pumps and lines of hose, and when an alarm is given they can often have a fire extinguished before the arrival of any outside firemen. The employment of steam pumps for such service has always been more or less unsatisfactory on account of the necessity of always keeping up steam and then often having it fail at the critical moment. For such service the electric current is the ideal agent, and it is beginning to find extensive employment in this special field.

A recent installation of electric-driven pumps for fire service is that in the Marshall Field department store, Chicago, a building occupying an entire city block and one of the largest of its class in the world. The outfit consists of a Laidlaw-Dunn-Gordon duplex underwriter pump connected by single reduction gearing to a waterproof electric motor. The pump cylinders, 8x12 inches, have a computed capacity of 700 gallons per minute at 140 pounds water pressure. The pump, besides its other special features, is claimed to be rust proof throughout so that it will not get out of ready running condition. The motor, furnished by the Chicago Edison Company, is shunt wound for 220 revolutions per minute at 230 volts, and is entirely enclosed, all the connections being carried thru pipes screwed into the frame, so that the device may be flooded without affecting its action. The fields and armature coils are cooled by fans on the armature shaft. Reliability and certainty of action seem to be assured at all times and under all conditions.

Industrial Education in Germany—VII.*

BY UNITED STATES DEPUTY CONSUL MEYER, CHEMNITZ, GERMANY.

COMMERCIAL SCHOOLS.

The commercial schools of Germany are of very recent development. Their history dates back hardly two decades in the last century. Before 1880 they were almost unknown, even in their elementary form. Their development was most rapid after 1890, and it was as late as 1898 before the first commercial high school was established. To-day no branch of industrial education is more popular or more highly appreciated by the country. Every government of the empire contributes annually to the funds set aside for the administration of commercial schools. The value of these commercial institutions in the industrial evolution of the empire can hardly be overestimated. They have contributed very greatly to the phenomenal development of German commerce and to the present commercial greatness of the empire. Two great classes of commercial schools may be distinguished in Germany—the ordinary commercial schools and the commercial high schools. The class of ordinary commercial schools can again be divided into two departments—the lower commercial schools and the higher commercial schools. The latter class must not be confused with the commercial high schools, which in the general system of education rank with the higher institutions of learning, such as the technical high schools, agricultural high schools and universities.

The most elementary form of commercial education is offered in the commercial continuation schools, which in the German educational system rank with the general continuation schools and the industrial continuation schools which follow directly after the common schools.

Elementary instruction is given in commercial arithmetic, commercial geography, commercial law, commercial correspondence, bookkeeping, modern languages, penmanship, shorthand, typewriting, transportation, history, etc. Not all of these branches are taught at every commercial continuation school. Great diversity prevails in the organization of these schools; yet they are carrying forward a wonderful work, elementary tho the instruction be, and are fitting large numbers of German youths for successful commercial pursuits. They are now found in cities of all sizes in all parts of the empire, and frequently have a very large enrollment.

In 1902 Prussia had 244 commercial continuation schools, with a total enrollment of 23,037 students. In the same year Bavaria had 20 such schools, Saxony had 47 schools, with a total attendance of 4,744 students, Baden had 23 schools, with 2,600 students, of whom 200 were girls.

In the educational system of Germany the commercial high schools rank with the higher institutions of learning. They stand on the same level as the celebrated technical high schools, agricultural high schools, and universities. These institutions are of extremely recent development, all having been established within the last five years. At present there are four commercial high schools in the German Empire, founded as follows: Leipzig, 1898; Frankfort, 1898; Aix la Chapelle, 1898, and Cologne, 1901. A fifth school of this grade is to be opened in Berlin in 1905, the plans for it having been accepted by the commercial organizations interested in its foundation and the outlined curriculum of studies and regulations having been approved by the government.

Much discussion has been carried on as to the necessity or wisdom of these commercial high schools, and literature on the subject has been rapidly accumulating. Especially in the early days of the Leipzig school did opposition to the idea wax warm. Since then the unqualified success of the Leipzig school, as well as of its three successors, has robbed the arguments of the opposition of much of their strength.

At the time of the agitation for a commercial high school at Leipzig a distinct need was felt for these institutions. The social standing of the mercantile classes was in need of elevation thru the leaven of a higher education, while the complexity and universality of commercial activities called for a broader and more thorough intellectual preparation for them. In Germany education invests a man with a peculiar social prestige, irrespective of his personality. A certain social status attaches to his formal intellectual attainments, as evidenced by his diplomas. That the lack of social recognition and prestige is a serious handicap to a merchant both in a private and in a business capacity requires no elucidation. The removal of this handicap was possible only thru graduation from some higher institution of learning.

The second mission of the commercial high schools, the dissemination of broader and deeper expert knowledge in the commercial world, is even more important than the foregoing, in view of the marvelous expansion of modern commercial activity and the rapidly increasing complexity of the business relations of those engaged in trade. The possession of such knowledge has become indispensable today. Untiring energy and large means no longer suffice to hold old markets at a profit.

The need for some higher commercial institution was palpable; the rapidly developing commercial inerests of the empire called for it; and it was to fulfill these various missions that, in spite of powerful opposition, the great commercial high schools of Germany were, one after another, called into existence.

The objections have, however, thus far been discredited by the uniform success of the four existing commercial high schools. Not only was the attendance

* Abstract from Consular Reports.

large from the beginning, not only is it rapidly increasing with each year, but the men who have gone out from these schools have vindicated the value of the instruction given there by making a place for themselves in the mercantile industry of the empire. Already some of the schools are proudly gathering the records of their alumni as splendid monuments to the value of the instruction which they offer.

The celebrated commercial high school of Leipzig has the honor of being the pioneer in this field, it having been established in 1898 by the chamber of commerce of that city, which assumed full financial responsibility for the institution.

Certain courses of lectures are given in the commercial high-school building, and others may be attended at the university. Thus in the summer semester of 1903 the following courses were given at the university as credited work in the commercial high school: Eight different courses in political science and economics—finance, statistics, money and banking, exchange, sociology in its practical aspect, elements of economics, and elements of political science; three courses in law—international, administrative, and commercial; three courses in commercial geography; one course in applied chemistry; and five courses in pedagogy, designed particularly for students contemplating entrance into the teaching profession. In addition to this a long list of courses is recommended to students as particularly valuable for those who wish to carry extra work. In the commercial high-school building itself are taught commercial arithmetic, bookkeeping, and general commercial technology. Special courses in stenography and typewriting have also been arranged. Modern languages are taught by capable professors of the university, emphasis being placed upon English, French, Italian, Russian, and Spanish.

The total attendance during the winter semester of 1902-1903 was 519. So large was the percentage of foreign students that the school practically assumed an international character, and offered an unexcelled commercial education not to a kingdom or to an empire, but to the world. Out of the 519 students 306 were Germans and the remaining 213 were foreigners. The commercial high school of Leipzig has made wonderful progress. In 1901 the total attendance was 353—228 of them Germans and 125 foreigners.

The commercial high school of Cologne, founded May 1, 1901, was the first independent institution of its kind to be established in Germany.

The course of instruction occupies two years of two semesters each. The curriculum comprises: Political economy: elements of political economy, transportation, commercial and colonial politics, social problems, organization of the world's commercial organizations, exchanges, insurance, history of commerce, public finance, industrial and agricultural politics, statistics, money, and banking. Law: elements of public law, commercial law, maritime law, law of exchange, law of insurance, elements of judicial procedure in Germany and foreign countries, laws of bankrupty of leading countries, elements of constitutional law, administrative law, international law, colonial law, industrial law (including patent rights, trade-marks, pattern registration, etc., both in Germany and foreign countries), general, social and industrial legislation. Geography and technics: general geography, materials and commodities of trade, colonial industries, general commercial geography, physics, chemistry, mechanics, general engineering, industrial sanitation, bookkeeping, commercial arithmetic, correspondence, and office work. Languages: English, French, Spanish, Italian, Russian, Danish, Norwegian, Dutch, and German (for foreigners). General culture: German history, foreign history, history of art, history of literature, and philosophy.

The rapid and continuous increase in attendance at the Cologne school shows both a need for and an appreciation of the instruction give there. The table presents the increase in the enrollment during the two years of life of the school:

Class of Students.	Semester.			
	First	Second	Third	Fourth
Regular	68	119	146	198
Seminary	18	17	7	8
Special	44	46	52	60
Hearers (irregular)	633	645	545	1,271
Total	763	827	760	1,537

ATTENDANCE AT THE COLOGNE COMMERCIAL HIGH SCHOOL.

There is no doubt in the writer's mind that the German commercial high schools, or commercial universities, are far superior to similar schools now being organized in the United States in the infusion of a strong current of practical instruction delivered by men actively engaged in commercial pursuits and bristling with information and pointers freshly gathered in a wide and varied experience out in the industrial storms and calms that hold sway where men battle with one another for the survival of the fittest.

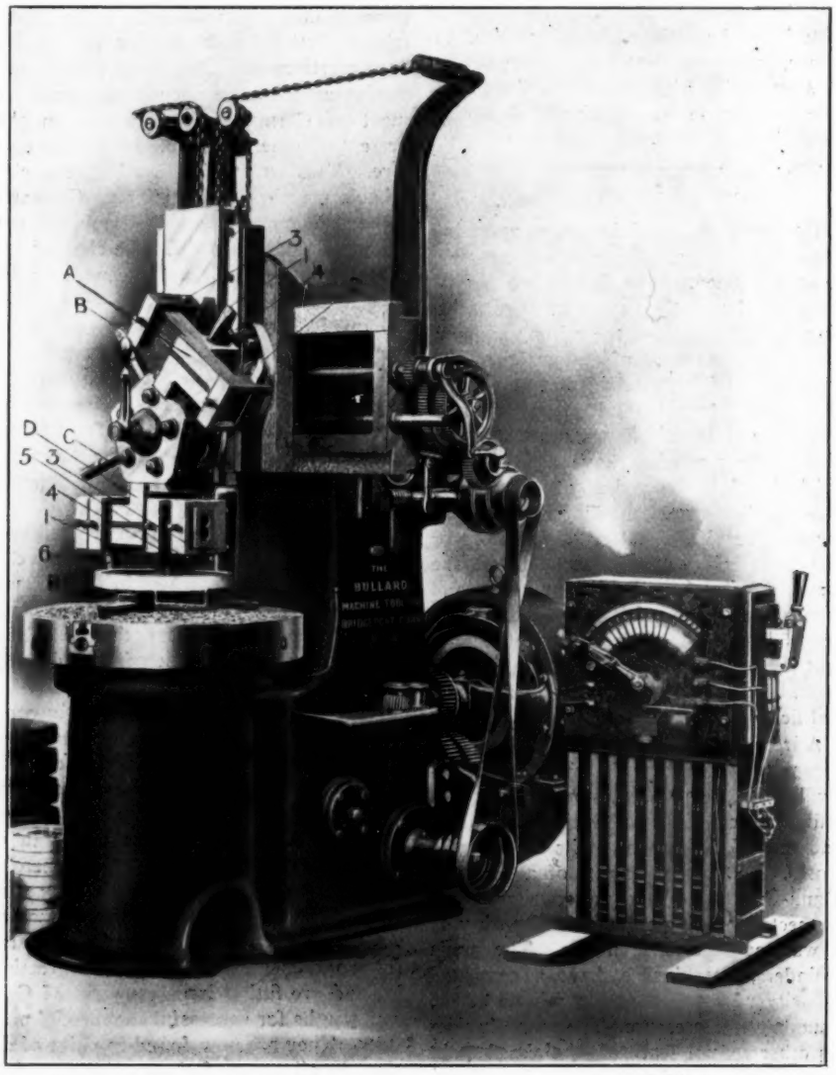


FIG. 1. BULLARD 30-INCH VERTICAL BORING MILL WITH TOOLS FOR MACHINING GEAR BLANKS.

Machining Gear Blanks on a 30-Inch Vertical Boring Mill.

The half-tone, Fig. 1, shows a 30-inch boring and turning mill with turret head, equipped with a full set of adjustable tools for finishing, with but two settings, gear blanks ranging in diameter from 4 to 24 inches, should prove of interest. The various operations and tool holders therefor are designated alphabetically, and the tools are numbered according to the successive operations performed.

The blank is secured by finger jaws gripping inside of the rim. It is readily brought true by the combination chuck in the table, and is brought level with the table by the parallel blocks on which it rests. Tool holder *A*, carrying the four-lip drill 1, the outside turning tool 2 and the facing tools 3 and 4 for the rim and hub, completely roughs one side of the blank while the hole is being rough bored. Tool *B*—a single-point boring tool—is next run thru the bore at a racing cut, to insure concentricity, leaving just enough metal to be cleaned up by the special universal joint reamer *C* to finish the bore absolutely true and to size.

Tool holder *D* is of the same design as *A*, but carries a standard size guide plug 1, which, in entering the bore, insures concentricity of diameters and also adds to the stability of the tool. Tool 2 finish-turns the outside diameter of the blank to size and has completed its operation before finish-facing tools 3 and 4 are brought into action on the rim and hub. The corners of the rim and hub are rounded off by tools 5 and 6.

In the second setting a stud (the diameter of the bore of the blank) is fitted into the center of the hole in the table and a driving stud set in the T-slot of a chuck jaw. A blank is then dropped over it and tool holder *A*, minus tools 1 and 2, roughs the faces of rim and hub, which are finished by the corresponding tools in holder *D*, the round corner being formed as before. The method of holding the blank from the inner surface of the rim insures uniform thickness of the rim when finished and, by the use of the guide plug in the finishing tool *D*, the outside diameter is not only turned absolutely true to size but runs on centers within 0.0005 inch.

The tools used in the holders number twelve, and all operations are completed without moving the turret slide from its central position on the rail, thereby saving all time usually required to set tools and caliper for diameters. Most of the tools employed are of the ordinary form and can be used on other boring-mill work.

The construction of the tool-holders is shown in the line engraving, Fig. 2, the body *E* being a steel casting finished practically all over and fitted with adjustable holders *F* carrying the rim machining tools. Near the shank is another pocket for a tool which operates on the gear hub. At the center is a Morse No. 4 taper hole for receiving the shank of a drill or other tool; along each arm is a shallow groove forming a seat for the clamping screws for the adjustable tool carriers.

All gears of the above sizes are finished in this way at the shops of the Bullard Machine Tool Company, Bridgeport, Conn., and it is stated that a saving of from 50 to 75 per cent. is made over the more common method of separate chucking and turning on arbors.

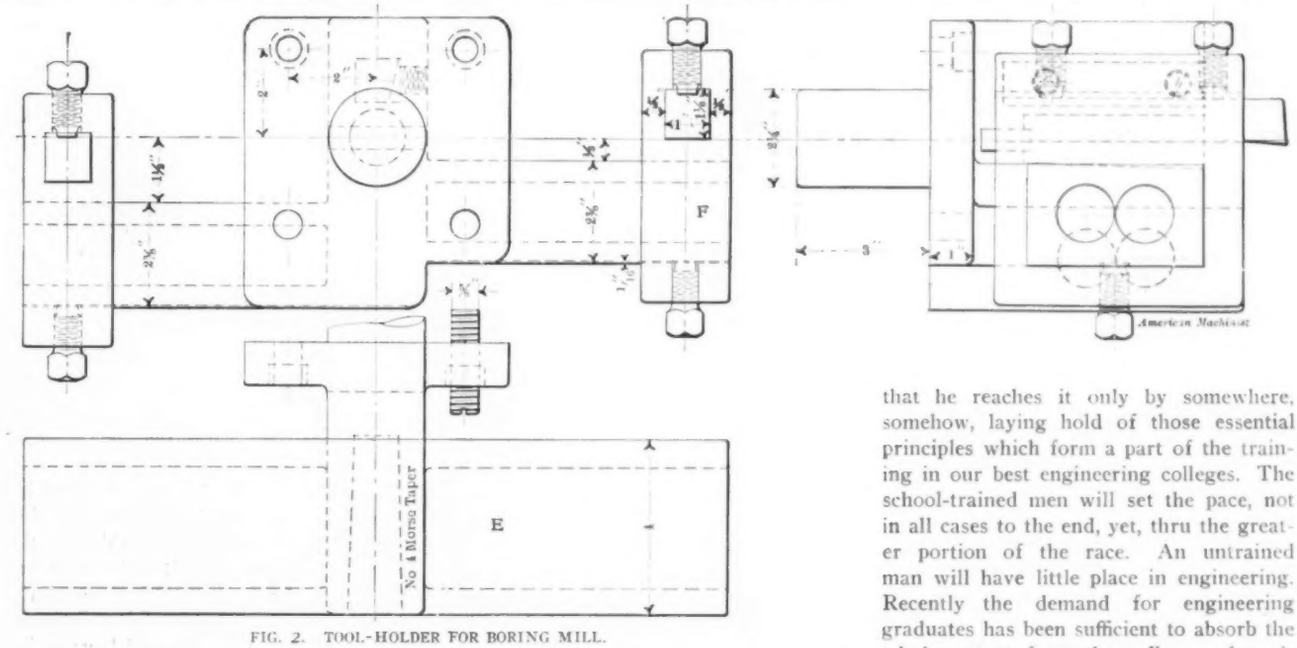


FIG. 2. TOOL-HOLDER FOR BORING MILL.

A right of way for a power-transmission line has been acquired by the Toronto and Niagara Power Company between Niagara Falls and Toronto, Ontario. The distance between these two points is 86 miles, and when the current of Niagara is transmitted to Toronto, it will be the greatest distance yet covered by a Niagara transmission line.

Opportunities of the Engineer Graduate.

In the following will be found some of the more striking and suggestive portions of the presidential address before the Society for the Promotion of Engineering Education at its annual meeting at St. Louis, September, 1904, by Frank Allen, Professor of Railroad Engineering at the Massachusetts Institute of Technology:

As to the character of the demand for graduates in engineering, it can be assumed without question that in the future, as in the recent past, for positions directly in engineering, the graduate of the engineering college will in general be demanded, and that even more than in the past the positions of prominence, the prizes in the engineering field, will mainly go to the school-trained men. It will, no doubt, be true that the "graduate of the axe-handle," the self-trained man, will always occasionally reach the top, but more and more, as time goes on, will it be true that he reaches it only by somewhere, somehow, laying hold of those essential principles which form a part of the training in our best engineering colleges. The school-trained men will set the pace, not in all cases to the end, yet, thru the greater portion of the race. An untrained man will have little place in engineering. Recently the demand for engineering graduates has been sufficient to absorb the whole output from the colleges of engineering.

In an increasing degree it has been found advantageous and desirable to secure superintendents, managers, presidents of railroads and other semi-engineering enterprises by promotions from among the school-trained engineers. The policy of that splendid railroad system, the Pennsylvania, has long since been established; the civil engineer engaged upon maintenance of way finds himself directly in line of the office of division superintendent, to whom in turn the office of general manager or even of president is in line and an evident possibility.

New fields for men trained as engineers are opening daily; looking backward for thirty-five years, it appears to be true that the opportunity for employment for the large numbers graduated now is definitely better than for the limited number of graduates at that early time. It is my judgment that the demand for engineers

that comes from the development of engineering enterprises is due in very considerable part to the fact that there has been available, in increasing quantities, a supply of competent engineers, and this in turn to the fact that in this country the opportunities for engineering education have been more general and its quality better than in the earlier days. In investigating any question of demand and supply, it should be understood that not only does a supply generally follow a clear demand, but it is also true that an adequate supply of a good article certainly stimulates and often even creates a demand.

In addition to the general principle just set forth, it is further true that in many instances individuals have largely or entirely created their own opportunities, and have often incidentally enlarged the general field of engineering opportunity and employment, so that the increased general demand has in many instances been due specially to the superior quality of the supply, as shown by some individual engineer. The city engineer of a small city in Massachusetts failed to secure reappointment when a change of administration was made. He had given careful study to road construction, which was then receiving much attention, and, at some apparent sacrifice at first, he continued to give special attention to this class of work, in which he attained acknowledged prominence. His influence was important in securing the appointment of the Massachusetts Highway Commission (of which he has always been the most active member, and is now chairman), which has constructed about 575 miles of State highways, with an expenditure by the commission of more than $4,500,000, besides aiding largely in the impetus given to highway construction the country over. The engineer largely created his own opportunity, the supply created the demand in his own case.

Two of the most important engineering projects in Massachusetts, the Metropolitan water supply and the Charles River basin, are the results of careful work and able reports by an engineer who was recognized as an able investigator, but who appeared to be shelved from active construction in his position of chief engineer of the State Board of Health.

The field chosen by the individual for his opportunity is not always pure engineering. While the demand for engineering and the demand from engineering enterprises, the demand for engineering education, is strongly on the increase, yet the day of trouble is before us, the day of financial crisis, when enterprises languish, when the demand falls sharply off and the supply continues, altho in diminished numbers. Then will come the time when the practising engineer and the engineering graduate will find a necessity, not now existing largely, to make for himself his opportunity, which will lie outside the established lines of engineering; when he must accept not what he would, but what may be offered, and the engineering graduate will be forced into general business, into manufacturing. It seems reasonable that his greatest usefulness will first be found with dealers in engineering or mechanical supplies, or in manufacturing where engineering skill can never be amiss; already the demand in these directions has become a reality rather than a possibility.

For the purposes of general business of various classes, if more than the high school course is to be attempted, what is there better for preparation than what a young man receives in our engineering colleges, as the courses are now arranged? An old saying has it that man admires woman for her beauty; woman admires man for his strength. In view of this saying, which has a large kernel of truth in it, the education needed for general business is one which shall give strength rather than beauty; the education which shall give intellectual vigor rather than mere finish; the education which shall early secure habits of industry, application and definiteness of knowledge rather than that habit of ease and comfort which seems almost essential to what we naturally think of when the word culture is used.

While there are always endless controversies in the educational field as to subjects and methods, there is recently much unanimity of feeling among our foremost educators that education should have as its object "training for power," as the expression is. Nothing in education is more important than that the student should be forced to think. The man who has experienced religion in a twinkling has no more surely caught a glimpse of a new world and a new life than the dull student who finally exclaimed to me, his tutor in a mathematical subject: "I see, you want me to use my good sense, and not my memory." He had seen the light; he was a dull student no longer, nor was I longer his tutor.

Not only do the studies in the engineering course tend strongly to secure from the student whatever advantages follow from thorough and interested application to work, but it seems also to be the fact that these studies, or many of them, are of the sort to supply the quality of training which a man needs in business life. The study of mathematics in lines advanced beyond the high school scope must certainly be of value to the man who desires to have a grasp in matters of accounting and finance. The study of science trains him to observe facts and phenomena and to draw correct inferences and conclusions from such facts. The basis of science is not guesswork, but observed facts; business procedure, also, should be founded on a knowledge of underlying facts, and the successful business man should be he who successfully interprets these facts. The student of science interprets his facts in the light of law, the laws of nature; the business man must carry on his work in the light of law, the laws of nature, of economic law and of business and legal restrictions. The engineering training is strongly analytical in its character; the graduate has learned to separate a problem into its elements, and to the controlling one he gives his immediate and special attention. In my mind, the successful analyst is more likely than others to have some synthetical power. The man whose analytical habits are well established is more likely than others to have some ability in organization. In modern business, where consolidations are almost the rule, the prime requirement is successful organization. The trusts, many of them, have failed of adequate success, often because the heads have been, in the nature of things, selected from the selling agents, the earlier salesmen, whose training has been other than in the direction of organization, whose knowledge of nature's law as applied to manufacture has been practically nil. In this connection, it is interesting to know that the first great master of railroad rates, the first commissioner of the trunk line pool, still rated by traffic men as greater than any of his successors, was Albert Fink, first known as an able civil engineer, a bridge engineer, the originator of the Fink truss. In all large enterprises the difficulty is to secure at once efficiency of organization. It was recently noted as a rare occurrence that the superintendent of motive power of a large system of railroads had organized his work so that on his return from a two weeks' trip there had accumulated three letters only which required his personal attention.

To my mind it is also true that the information acquired in the engineering course is likely to prove of value to the business man, altho we all understand that this is not the important feature of the education. A knowledge of chemistry, of physics, of the properties and laws which determine the behavior of materials, a proper understanding of the nature and laws applying to the use of steam, electricity and water-wheels, or, in other words, an understanding of power and its use; these at least constitute a resource for understanding and handling things material and mechanical, which ought to be of value to any business man.

But beyond all this is the moral training, the training in character, which is a natural result of an intimate acquaintance with science, of close contact with scientific methods and reasoning. The study of science is, it must be, the search for truth, and it must from usage cultivate a love for truth. That the scientific attitude of mind is of supreme importance as an element of character building seems to me on principle to admit of no doubt. As a matter of observation, I know of no class of men whom I believe to be less subject to business corruption than the civil engi-

neers who have come more especially under my notice, and I do not doubt that the school-trained mechanical, electrical and mining engineers are men of equally high character. The influence of training in mathematics and science is also calculated, it seems to me, to develop another important element of character. The student learns in mathematics that correct procedure will secure correct results; in science correct observation and proper reasoning again will secure correct results. A clear appreciation of these truths naturally leads to the establishment of that quality of character which we call courage. An engineer, unless he is trained so as to have acquired something of courage, is comparatively valueless.

There are many fingers pointing to the value of a training in science as the one thing needful to make the man who shall rise above his fellows. Following this idea, it is an interesting coincidence, if it be no more than this, that President Eliot, of Harvard, was, before assuming the presidency, for a number of years an experienced teacher of mathematics and chemistry. The reputation of President Hadley, of Yale, was established as a lecturer upon railroad transportation, and as a member of the editorial staff of the *Railroad Gazette*, and his first lectures on the subject were delivered at a prominent engineering college. President Van Hise, the recently elected president of the University of Wisconsin, is a geologist and took the engineering course at Wisconsin. President Remsen, of Johns Hopkins, is a chemist; President Jordan, of Leland Stanford, Jr., a biologist; President Schurman, of Cornell, holds, among others, the degree of doctor of science from the University of Edinburgh.

In my judgment, not only is it true that graduates of engineering courses will find it necessary to enter into the field of general business, but I believe that their success will be sufficient, so that this necessity will be most fortunate for the cause of what we are all interested in as engineering education. With the increased activity which will follow, broader fields will there open out, and other important outlets for our graduates will be recognized and accepted.

With the growing importance in the world of matters engineering and mechanical, there must also be a demand, constantly increasing, for journalistic work, not only for technical periodicals, but for newspapers and general publications. Not only on the side of an appreciation of the technical of engineering application of many matters of interest to the public, but also upon the literary side, there is no reason why engineering graduates should be at a disadvantage. If the engineering training tends to clear thinking, as we believe it does, it ought also to tend to clear writing. A clear view of an idea to be expressed is the first requisite to clear expression. The engineering training tends strongly to secure not only clearness, but, it seems to me, simplicity of style, and if these be secured little else need be desired.

It must be clearly realized by educators, it must be convincingly explained to practitioners, that the engineering college is not intended and cannot be expected to bring to its graduates a knowledge of or even an acquaintance with many subjects most essential to the success of an engineer. The problem is rather to utilize a limited period (at present four years) in training the student, in developing his capacity for understanding matters of engineering, so that as opportunity offers he may develop into the successful engineer. On one side is the clamor for attention to culture, on the other for information courses of various sorts, often with little or no training value. Most of what we regard as culture must depend upon environment and habit and must be acquired outside the college walls, in the home, the club, the church. Very little of real culture, little more than a taste of it, can be acquired directly from the work of instruction in the small fraction of time properly available from any college course, academic or engineering. Little in the way of experience or information can be securely acquired in an engineering course, and little should be attempted. The engineer as employer, the manufacturer as employer, must come to realize that upon him rests the necessity of providing his promising employees the opportunity to learn business methods, to acquire engineering experience. The graduate must understand that the college has not educated him, but has provided a foundation firm and strong upon which he may educate himself so as to become a competent engineer and a cultured gentleman. The problem for the engineering teacher, for the engineering college, is no more, no less than to provide this foundation, which must have breadth, but also depth and solid fiber throughout. The success of engineering education depends upon the steadfast maintenance of this attitude as to the function of the engineering college, as its part in the making of the man and the engineer.

The Great Western Stove Company, of Leavenworth, Kan., has closed down its works for two weeks in order that its men may have an opportunity to visit the World's Fair at St. Louis. After paying the men off in full the firm made each man a present of twenty-five dollars toward defraying his expenses to the fair.

Each native of the Igorrote Village on the Philippine Reservation at the World's Fair has been presented with a wheel by the Columbia Bicycle Company and is now busily learning to ride. The best rider will be entered in the next bicycle meet in the Stadium.

Letters From Practical Men.

That Jack-in-the-Box Speed-Changing Device.

Editor American Machinist:

With the device shown by Mr. De Leeuw in Fig. 2, at page 1189, and reproduced here as Fig. 1, if D is held rigid, then the pull applied at C will be doubled at A and the speed of A will be half that of C. Whether E be stationary, or given motion in either direction, the pounds pull on A will not be increased or diminished, and herein lies the apparent paradoxical result, since we all know that with any mechanical device "power times speed = power times speed."

G and H are levers, the teeth meshing with C being the points of application of

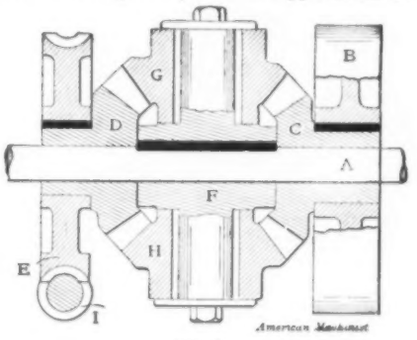


FIG. 1.

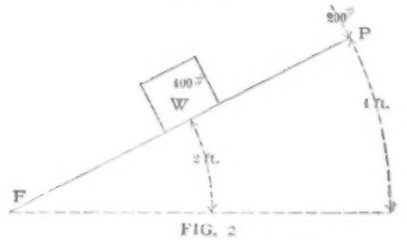


FIG. 2

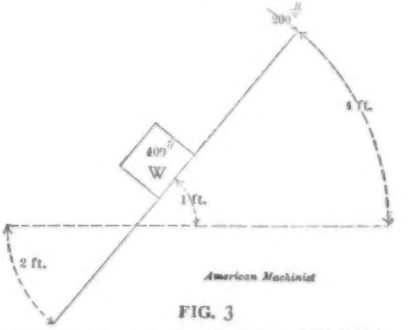


FIG. 3

THAT JACK-IN-THE-BOX SPEED-CHANGING DEVICE.

power, the teeth of D the fulcrums, while at trunnions F is the weight to be moved. With D fixed the resultant pull is double that applied at C, but with D moving in direction opposite to C, say at half the speed, we are simply allowing the fulcrum to be pushed backward by the lever, and since the speed of $F = \frac{1}{2}(C - D)$ we have F moving at one-quarter the speed of C without relieving the parts C, F or D of a single pound of pressure. With this device, no higher power can be transmitted than with D fixed and the greatest power applied at C which the belt is capable of

transmitting. Take the example of a plain lever, as in Fig. 1. If 200 pounds moves P thru a distance of 4 feet, a load of 400 pounds placed at W midway between F and P will be moved thru 2 feet. If, however, the fulcrum F is allowed to move back 2 feet during the time in which P is moving forward 4 feet, as in Fig. 3, then W has advanced from starting point $\frac{4-2}{2} = 1$ foot. But will anybody claim that the weight could be four times the power, simply because it moves one-fourth as far as the power? An important item of subtraction must be neglected in order to arrive at such a conclusion, and hence it would appear that Mr. De Leeuw has largely overestimated the pulling power of his lathe. Instead of a 16-inch pulley developing a pull of 7,640 pounds on 30 inches diameter, he has in reality $\frac{16}{30} \times 50 \times 3\frac{1}{2} \times 2 = 186\frac{2}{3}$ pounds (theoretical) pull, allowing 50 pounds per inch of belt width.

GEO. W. HART.

Cam Milling Tools.

Editor American Machinist:

The enclosed sketches and description of tools for milling gasoline engine inlet cams may be of some interest to your readers. Fig. 1 is a drop-forged cam. It is first bored, faced and the keyway broached, and is then ready for milling. Fig. 2 is the milling mandrel, made to fit the hole in the cam and provided with two Woodruff keys to locate the work. The two ends of the mandrel are milled flat at right angles to the keys. Fig. 3 is the locating center, made to fit the dividing head spindle. It is first bored to receive a center, and then a ½-inch slot is milled, into which both ends of the mandrel are made a nice fit. Fig. 4 is the formed cutter, made to the shape of the cam and can be ground without changing its form.

The rig is set up for milling as follows: The locating center is put in place, and a ½-inch parallel piece about 12 inches long is placed in the slot at right angles to the table, and with a surface gage is set till both ends of the parallel are the same hight from the table. The next thing is to set the mandrel central with the milling cutter. This is done with the aid of a round gage whose diameter is 0.002 inch less than the round part of the cam ($1\frac{1}{2}'' - .002''$). This is put on the mandrel and the latter placed between centers. By using a piece of tissue paper as a feeler between the gage and the cutter, the mandrel can be brought exactly central with the cutter.

Fig. 5 shows the mandrel ready for business. As can be readily seen, only half of the cam is milled at a time; for the second cut the mandrel is reversed end for end, the flats at the ends of the mandrel locating it. It is important that the tools should be accurately made and set right, otherwise the junction of the two cuts will be uneven. The milling of this job (including the setting) was done by an apprentice boy, and was entirely satisfactory, both as regards quality and quantity of work produced.

L. MYERS.

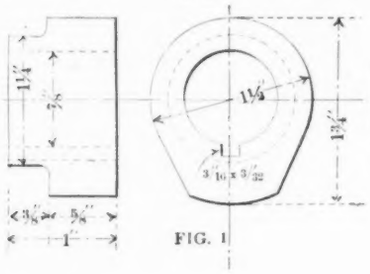


FIG. 1

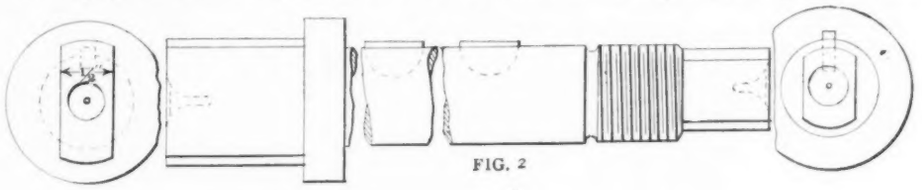


FIG. 2

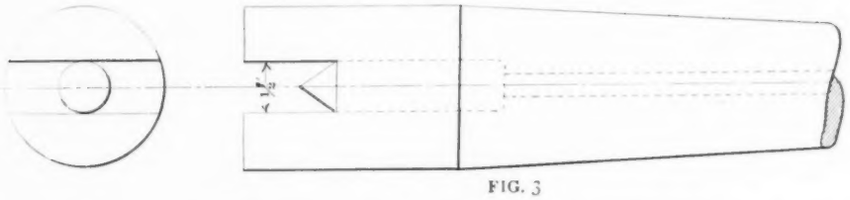


FIG. 3

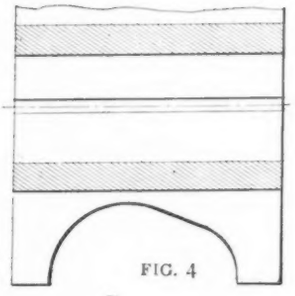


FIG. 4

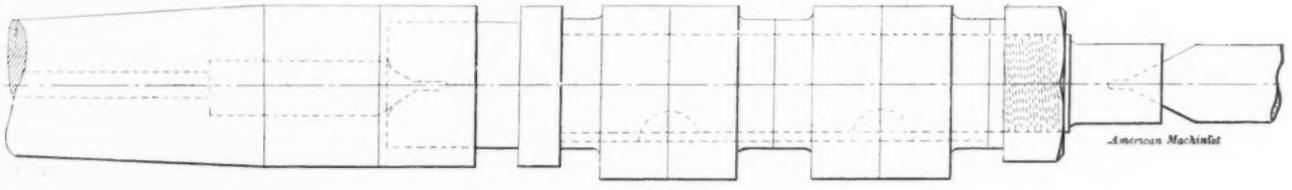


FIG. 5

CAM MILLING TOOLS.

That Sketching Device.

Editor American Machinist:

In the article, "A Sketching Device," at page 1272, I recognize an old friend in a new guise, nothing similar to which has appeared in the technical papers for some time.

Let us see how we would use this handy tool. The chief comes to your board and tells you to go to the machine shop and make sketches of several castings. You pick up your sketching device and start for the shop, full of joy because you have such a handy tool.

The first thing to do is measure a casting and thus determine the scale to which you will make the sketch. This done, you locate all your center lines by measurements taken from the casting. From these center lines you must fill in the outline, it, too, being measured from the casting. After this the dimensions must also be placed.

By the time you have sketched the first casting, the chief will send out to see if you have met with an accident; before you have finished the last one, the chief himself will come out and give you a written order for your money. Now, it might not end so badly as that, but I think that one trial of this device would be enough for any hard-working, self-respecting draftsman.

Why is it necessary to use a square of any kind to make a preliminary sketch, either in the shop or drawing room? Ask a good man to go into the shop and measure up a machine, or part; you won't see him take a fancy sketching device, but he will grab any old sketch pad or note book, a rule and probably a pair of calipers. That man will return in a short time with a fully dimensioned sketch. This sketch will not be a work of art; the straight lines will be wavy, and the curved lines may be rather doubtful, with no pretensions to scale, but still this answers as a preliminary to a general or detail drawing. Freehand sketching is much better

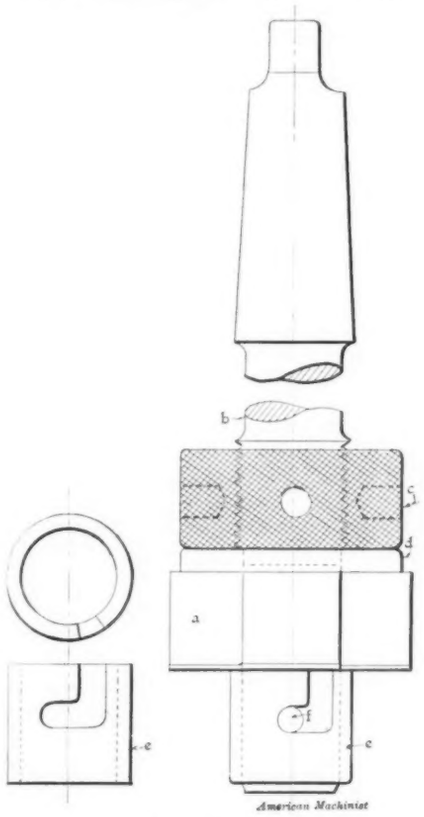
training for the eye and hand than mechanical work, and not the least virtue lies in the fact that it can be done in less than one-fourth the time required by the handy sketching device route.

C. A. C.

A Facing Cutter.

Editor American Machinist:

I am sending you a sketch of a tool for facing up working surfaces for nuts, bolt heads, etc., on work that has not to be machined all over. The cutter *a* is held fast in the bar *b* by the nurled nut *c* with a steel washer *d* between, as shown. The bush *e* is of hardened steel, with a slot in



FACING CUTTER.

it that fits over the pin *f* which keeps it in place on the bar. One bar will cover a good range of work, with a number of different sizes of bushes, and the latter are easily changed to suit different holes.

Newport, England. J. WHEELER.

School Drawings.

Editor American Machinist:

At page 1237 C. H. Norton shows a drawing reproduced from work done in an evening school in Boston. The drawing is such that no shop man would ever attempt to work from it. Mr. Norton asks if there is not some way in which this gulf between our schools and our practical engineering establishments can be bridged.

There certainly is a way in which it can be done and in some few places it is being done. The surface gage drawing enclosed herewith is a fair sample of the work required of the students in a certain Chicago school. Drawings are made here for actual use in the shops, and the students know this. They are taught to do the work carefully and well with this fact in view. Quite a large number of surface gages have been made from this drawing. The worm and worm-wheel for tilting the spindle are made by the method explained in the AMERICAN MACHINIST, Vol. 26, page 1335.

The trouble with many schools lies in the fact that school boards, boards of regents, school superintendents and college presidents, as well as others in authority, know little of things mechanical. They know the value of a teacher of ancient languages or mathematics because they have been thru the mill themselves, but they are apt to belittle a mechanical education; and, as expenses must be kept down in some way, the shop men are frequently paid very low salaries and, of course, no competent man will accept such a position. The way to bridge the gulf is to get one or more educated practical mechanics on each controlling board and let these men see to it that competent teachers are employed and that they are offered sufficient compensation to induce them to take up this very important line of work. It would be of great assistance to both teachers and pupils if the best technical journals were taken and kept on file where they would be easily accessible for reference at all times.

This particular school was founded largely thru the efforts of a well-to-do manufacturer who for many years has taken great interest in it, and the results speak for themselves. Graduates of the school are holding responsible positions in many lines of mechanical work. Some of them are in business on their own account.

WILBERT S. DREW.

University High School, Chicago.

[The drawing submitted by our correspondent is a practical working drawing in all respects, and one which would do credit to the drafting room of any manufacturing establishment.—Ed.]

A Small Milling Fixture.

Editor American Machinist:

Fig. 1 shows a piece of work of which we had a thousand to make. They were to be made from gray iron. The limit of error, except in the case of the outside diameter, which was not important, was 0.002 inch, and the top must run true with the hole. The drilling, reaming and squaring up were ordinary turret lathe operations, but milling the top was an operation a little out of the ordinary. Fig. 2 shows the milling fixture. It was made from tool steel throughout. The nut was hardened all over, but the base was hardened only on the taper end. After being hardened the nut was screwed on and ground on the end so as to be true with the taper, which was ground next and fitted to the taper hole in the work, so that the piece would drive down 3-32 inch to the nut when the latter was screwed down tight to the base. A hole was tapped in the table of the milling machine, and the screw *A* made a tight fit in the base but a loose fit in the hole in the table, so that any inaccuracy in the hole would not prevent the fixture from resting squarely on the table when screwed down tight. This fixture proved very rigid, in fact it could stand more of a cut than the machine was capable of pulling. There was 1-16 inch of stock to come off, and this was removed with one cut without a chatter mark. After the

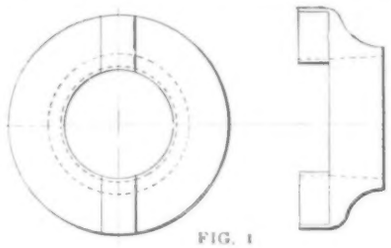
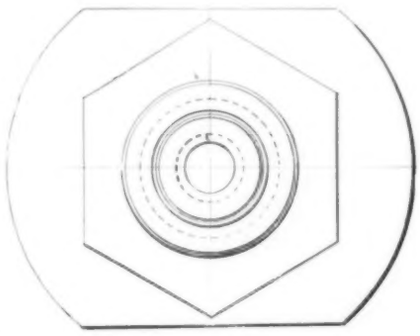


FIG. 1



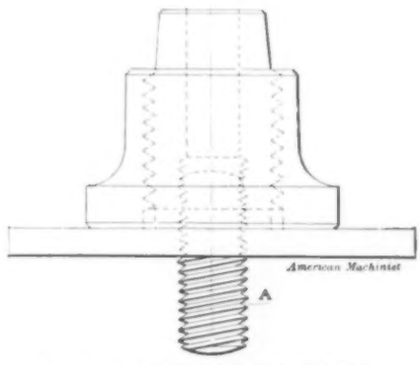


FIG. 2. A SMALL MILLING FIXTURE.

machine was rigged up there was no chance for any variation in the pieces inside of the limit. We were handicapped by not having a milling machine heavy enough, so didn't make any records on this job. The simplicity of operation is the chief beauty of the fixture, the operator driving a piece on with the nut screwed down tight to the base, milling it, and then giving the nut a half turn, this being sufficient to loosen the piece and allow it to be removed with the hand. With a small boy running the machine the cost of milling was very low.

PAUL WESLEY.

A Grinder's Troubles.

Editor American Machinist:

In reading over the remarks at page 1243 about "Grinder's Troubles," and also what the editor says in regard to them, I think it would be well for us all to wait until Mr. Henry has made the test of his machine and given us a diagram showing its condition.

If this test is carefully and intelligently made we can then enter into a discussion. Until that time any further discussion seems to me very far from the mark.

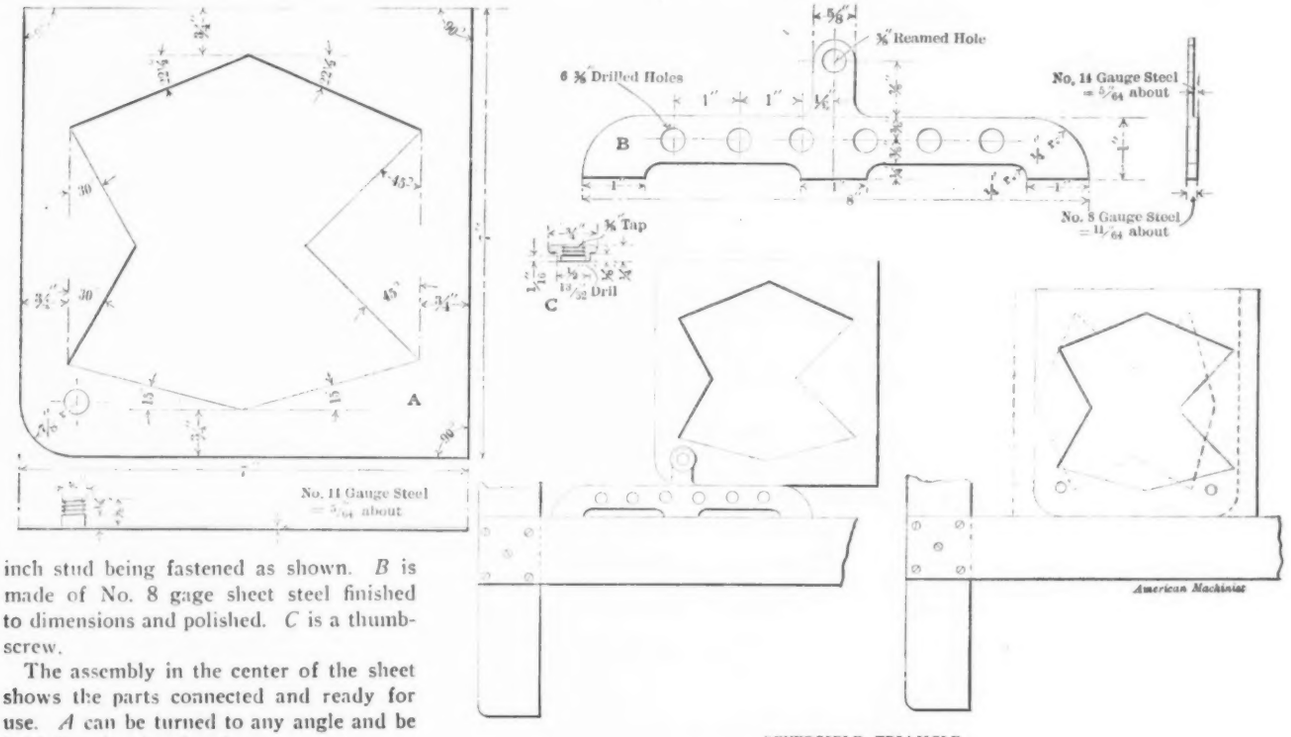
C. H. NORTON.

A Draftsman's Reversible Triangle.

Editor American Machinist:

Enclosed please find a sketch of a reversible triangle which I have been using for a short time and find it to be superior to any other.

A is made of No. 14 gage sheet steel finished to dimensions and polished, a ⅜-inch stud being fastened as shown. *B* is made of No. 8 gage sheet steel finished to dimensions and polished. *C* is a thumb-screw.



REVERSIBLE TRIANGLE.

The assembly in the center of the sheet shows the parts connected and ready for use. *A* can be turned to any angle and be held firm by the thumb-screw.

In the lower right-hand corner, *A* is shown used directly against the T-square. It takes the place of 15-, 22½, 30-, 45- and 60-degree triangles.

ARTHUR W. MCALPINE.

Stealing Men—"Help Wanted" Advertisements —A Foreman's View.

Editor American Machinist:

I read with interest "Steelwork's" letter, at page 1210, on "Stealing Men," etc. I have several times been guilty of this crime (?) myself, and my conscience is as clear now as it was before. As foreman of a machine shop, it is certainly up to me to get the best possible results for the amount of money expended. This cannot be accomplished short-handed or with inferior help.

Nearly every machine-shop foreman (of course I mean the real thing, not a figurehead) has worked in other shops and on different classes of work. Many a foreman has had charge of other shops, so what more natural when he sees a weak point or a vacancy (machinists will sometimes quit, or, as "Steelwork" puts it, "discharge the firm") than to remember that Bill, who worked for or with him in S——, was hard to beat on this class of work? He knows what wages Bill is getting at S—— and that he can pay enough more to induce him to make the change.

My way in this case would certainly not be to sit quietly down and wait for Bill to ask me for a job, nor to take the next man that came along and try to break him in. I should either see or write to Bill and tell him exactly what inducements I could offer. If that got him to come to me, I would have accomplished three things at least: I would have improved Bill's condition, given my firm better service, and got rid of one more night sweat for myself. Very likely, too, I would have incurred the ill-will of the firm Bill had been with as he was a valuable man there, otherwise I should not have taken the trouble to get him.

On one occasion, a few years ago, the firm I had stolen two men from (I had been in their employ myself for some time) sent me word by one of the stolen that they "would remember me for that." I am still waiting for the remembrance.

I am inclined to think the words "stolen" and "thief" depend a great deal on "whose ox is gored." If a man is taken from me, he is stolen and it is an underhand trick; if I induce a man whom I need to leave a competitor, it is strategy and shows good business ability.

In this locality (a little out of the manufacturing districts) the work is mostly repairing, and when my firm undertook the manufacture of a product including many small duplicate parts, it was impossible to use much local talent. We had up-to-date machinery and had to have some up-to-date men.

I had to steal men or to advertise, and I did both. I had only fair success thru the advertisements. The cause of this I attribute to the idea which I know exists among mechanics generally that no really good job goes begging for men thru the papers. They think "there's a nigger in the wood pile" as soon as they see such an advertisement.

This idea, I consider, is entirely wrong. I know of a great many good firms advertising in both local and trade papers that really have very good jobs to offer. In fact, it has been my experience that such firms are the rule rather than the exception. It is the exception, however, that gives the idea that all advertisements are snares. Ill news travels fast, and the firm that tries this confidence game often is soon known to the trade all over the country.

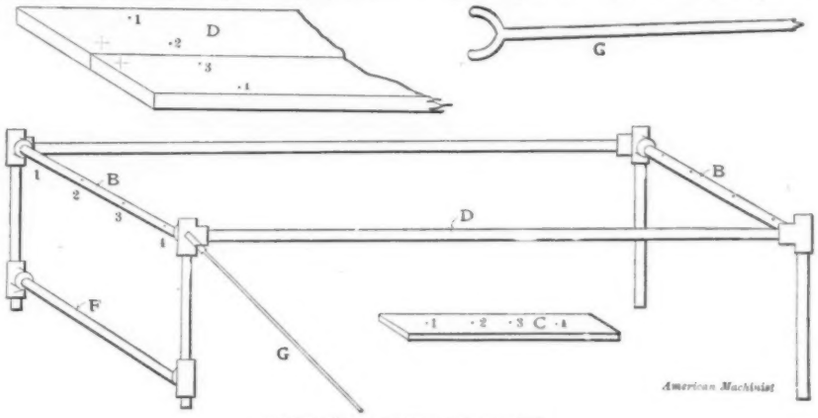
You will hear, wherever machinists congregate, the story of someone who has been bitten by a fake advertisement. What you do not hear is of the hundreds of good positions secured thru answering advertisements. As a rule, the better positions are secured thru trade papers, as the firm which wants extra help for only a short time generally advertises in local or nearby papers.

KIOWA.

A Home-Made Portable Bench.

Editor American Machinist:

The cut shows a portable shop bench used for pipe cutting, vise work, etc. It is made of 1-inch pipe and fittings. In its skeleton form it can be used to hang tongs and such things on, as a rack to stand things in and for similar purposes. If to be used constantly in one place it can be fastened down by straps fitting over the lower crossbar *F*, or flanges can be screwed on the feet. Another crossbar *F* can be put at the other end, and boards may be laid on for a shelf. Pipes may be screwed into the tees at the corners and reaching to the ceiling near enough to be wedged down in that way, and then no other fastening is required. Long threads or right and left fittings are used when necessary for assembling. Braces *G* can be used, the fork catching in the angle of the fitting and the pointed end sticking into the floor. Bolt holes 1, 2, 3, 4 are drilled in pipe *B*, matching holes in plates *C*, 1½x¼ inch, and in the planks *D*. The planks are laid over the pipes, and the plates are laid upon them, and the bolts, say stove bolts, fasten all securely. The pipe vise is then fastened on the planks at *x x*.



HOME-MADE PORTABLE BENCH.

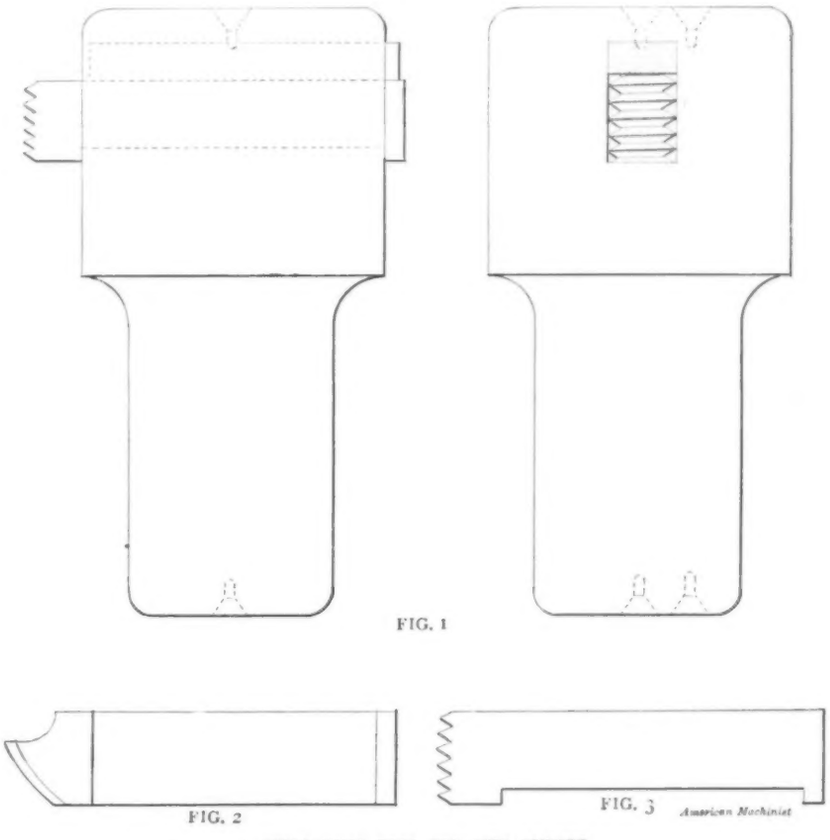
A Threading Tool for the Turret.

Editor American Machinist:

The sketches illustrate a threading tool that I have made and used in a turret with good success in large holes. Fig. 1 shows the holder with two sets of centers, and shows also the method of holding the thread chaser. One pair of centers was used to turn the holder and the other to turn and thread the chasers, and at the same time give the teeth clearance. The distance between these centers is 5-16 inch, and they are at right angles to the slot for the chaser. To sharpen, it is only necessary to grind the chaser on its face, as in Fig. 2, which shows a chaser after repeated grindings. Fig. 3 is a new chaser, the thread being cut tapering. As the thread is started by engaging the lead-screw in its nut and by bringing the turret on the cross-slide against a stop for a gage, each tooth on the chaser removes a certain amount of stock as it passes thru the hole to be threaded. This amount varies with the pitch and the number of teeth on the chaser. The chaser shown is 8 pitch and contains 8 cutting teeth tapered from the first tooth, which projects 0.0135 inch from the bottom of the thread, each succeeding tooth projecting the same amount beyond the preceding one. As the single depth of thread of this pitch is 0.108 inch, when the last tooth passes thru the hole, it leaves a full thread cut to size.

It is not an expensive tool to make, and the amount of work that it will do over the single-point thread tool with its many faults will surprise the most skeptical. A set of chasers of different pitches for this holder will be found an important addition to the turret-lathe equipment.

Jos. H. Blair.



A THREADING TOOL FOR THE TURRET.

A Simple Method of Proving a Multiplication.

Editor American Machinist:

Whenever I want to find out if I have multiplied two numbers correctly I use this simple method to prove it:

Example 1.

4	× 6	=	24
22	13		2 + 4 = 6
134.95 × 3.1416			
80970			
13495			
53980			
13495			
40485			
423.958920	42		4 + 2 = 6

Example 2.

6	× 3	=	18
15	21		9
.375 ×	.1875		
	9375		
	13125		
	5625		
.0703125	18		1 + 8 = 9

Add the figures in the multiplicand, and if the sum consists of more than one figure add them again until there is only one left. This operation is also performed on the mutiplier and product. Now multiply the two new factors, and if the product consists of more than one figure add these again until there is only one left. The number representing this sum must be the same as the number representing the sum of the original product—in the first example, 6; in the second, 9. H. I.

The Accident to the "St. Louis".

Editor American Machinist:

Mr. Amos Price at page 1207 puts in a good word about my description of the accident to the "St. Louis," but goes on and says "but not in exonerating the one who tightened the bolt." It grieves me sorely to contradict a man who has spoken well of anything I have written, for they (the men who speak well) are remarkably scarce. The editor in this case was, however, right, from my point of view, at any rate.

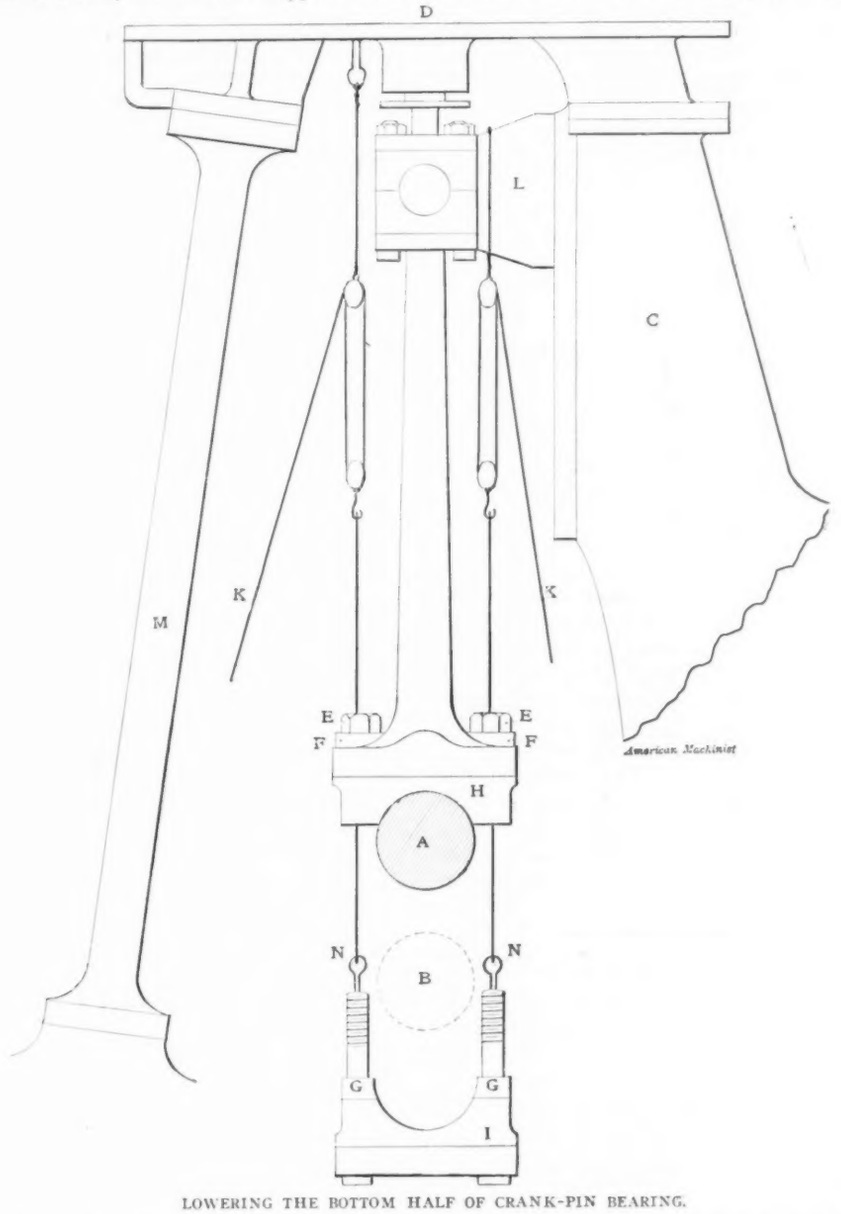
I will try to explain how this tightening up of crank-pin nuts is done.

I may mention that I have been a marine engineer; that I, like all the senior engineers on board the "St. Louis," have served an apprenticeship as a machinist. I do not write this out of mere braggadocio, but to show that I have lived the life and performed the work that the engineer in charge of the tightening of that crank-pin bolt has. The machinist in the shop of course knows how the first adjustment on these crank-pin bearings is done; how the rods are swung on their bearings, etc. When the crank-pin-bolt nut is screwed up to its proper place, the nut is marked, as is also the connecting rod or the washer, this washer being kept from turning by two dowel pins in the connecting rod. After the job has run a voyage (be it a few days' run across the Atlantic or a few weeks to the other side of the world) the crank-pins are inspected. As the tackle that is generally used to do this job would probably interest "shore" people, I will describe it and how it is used: The ends of the crank-pin bolts are drilled and tapped for eyebolts. These eyebolts are of such dimensions that they will pass thru the nut. On the columns or under the cylinders are located two eyebolts, one at front and one at back, just over the two bottom end bolts when the crank is on the top or bottom center and the ship is on an even keel. Two chain blocks are hooked into these two last-named eyebolts and two eyebolts with a piece of chain attached to each of them are screwed into the ends of the crank-pin bolts. These chains and eyebolts are generally made for the purpose, and the chains are of sufficient length that the crank-pin cap and its brass can be lowered clear of the crank webs when the crank is on the top center. These chains are used because the average bottom block of a chain hoist would not pass thru the nut. The blocks are then hooked on and the strain is taken by two firemen. The set-screw or other device for checking the crank-pin bolt nut is then eased and a short, heavy spanner wrench is put on the nut. There are three ways of loosening that nut. The first way is to pull it round with block and fall and windlass, which is tedious and clumsy. The second is to rig a swinging ram and ram the wrench around. The third, and probably the best way (even in spite of what the correspondents of POWER write), is to use a heavy sledge. The wrench is generally very short, not over 12 to 18 inches from the center of the nut, so as to clear the column. (I have not yet met the man who could strain a 5½-inch bolt very much by patting a 12-inch wrench with a 56-pound hammer.) After the brass has been lowered away, the pin is inspected, wiped off carefully, as is also the brass. Then, according to his own individual taste, the engineer lays several pieces of lead wire in the brass. The firemen heave up on the chain blocks, the nuts are slipped on the bolts as they appear thru their respective holes in the connecting-rod end. The nuts are then driven up solid to the old marks and then slacked off again. The lead wires which have been flattened are then inspected. The engineer decides whether a liner should be taken out or what should be done.

Remember the nut is always tightened up to a point decided upon by a trained engineer—a man who knows his work—which, I am sorry to say, is not always the case in this country. It would be impossible for a man with a sledge and an 18-inch wrench to overstrain a 5½-inch bolt. If too many liners were left out, he might pinch the crank-pin so that the bearing would run hot—but overstrain the bolt, never!

The accident was due to a large flaw in the bolt, as I was told by one who saw it, and that flaw was probably in the bolt when it came from the forge.

In the illustration the crank-pin is shown in section at *A*. *B* is the shaft, *C* is the rear column, *D* is the cylinder, *E E* are the crank-pin-bolt nuts, *F F* are the washers doweled to the connecting-rod end to prevent them turning, *G G* are the liners, *H* is the upper half of crank-pin bearing, *I* is the lower half of crank-pin bearing. The falls *K K* are made fast, one to the crosshead *L* and the other to an eyebolt screwed into the bottom of the cylinder. *M* is the front column, *N N* are the two eyebolts screwed into the ends of the crank-pin bolts.



LOWERING THE BOTTOM HALF OF CRANK-PIN BEARING.

DIXIE.

Variable Speed Countershaft.

Editor American Machinist:

At page 1281, Fig. 3, showing the action of the variable-speed countershaft, contains an error made in naming the central diagram as mean speed. A few figures will prove this: Assume countershaft ratio 9 to 1; constant shaft speed 300 revolutions per minute; variable shaft 100 to 900 revolutions per minute; disk diameters variable between 4 and 12 inches; even diameters 8 inches. Then

Min. speed = 100 r. p. m.
Max. speed = 900 r. p. m.
Mean speed = 500 r. p. m.

With even diameters our variable shaft would run at the same speed as the constant shaft, which is 300 instead of 500 revolutions per minute, showing an error of 200 revolutions per minute.

ERNEST J. LEES.

Neglect of Lubrication—A Simple Grease Cup.

Editor American Machinist:

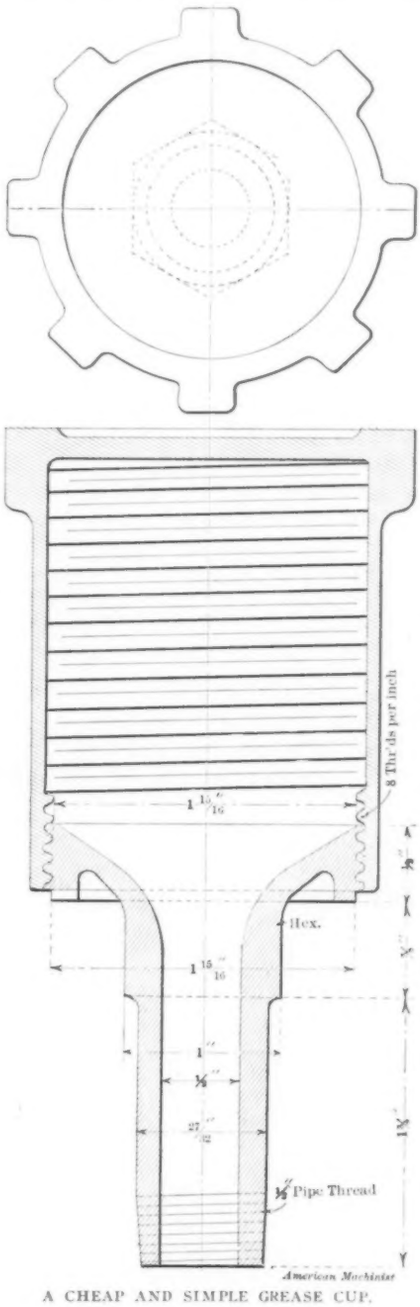
I have found in nearly all drawing rooms, and shops as well, excepting, of course, where they were makers of standard lines of machines, such as engines, dynamos and the like, that far too little attention is given to the proper methods for greasing and oiling the various parts of the machines.

Give a draftsman, or a designer if you please, a new machine to design, and it's "dollars to doughnuts" that proper lubrication for the machine receives practically no thought, at least until the job is nearly completed, and perhaps he won't think of oiling it at all. Should lubrication be thought of the job will go with a few ¼-inch or ⅜-inch oil holes at various places for someone to squirt oil at occasionally. On the other hand, had Mr. Designer given the means of oiling proper thought from the beginning, the whole design would have been modified. For example, instead of "squirt holes," as we used to call them in the shops, he would have put in ring-oiling bearings, or maybe would have cast a special reservoir that could be filled with oil-soaked waste or arranged to have room for a compression grease cup, or some other special device as the case might require.

The real necessity and value of proper lubrication are not appreciated by anyone until he has seen bills come in for repairs, and especially if he has had to pay them. Then there will begin to be inquiries as to why things wear out so fast, resulting in the draftsman having to make a few changes.

Coming back to grease cups: I have seen a good many, some fairly good, others bad, and most of them loaded with a whole lot of fancy "jim-traps." Now, what is wanted, according to my idea, especially for the general run of rolling mill or other mill work, is something like what is shown in the accompanying sketch. A good grease cup should have the following points in its favor: The oiler with greasy hands must be able to screw it down until the grease is forced into the bearing. The grease cup must be simple in construction, durable and easily screwed either way without sticking. It should not "leak" grease between the cap and base.

As for simplicity, we have here only two pieces, the cap, which is gray iron, and the base. This is made of brass,



A CHEAP AND SIMPLE GREASE CUP.

altho I don't see why malleable iron wouldn't be just as good. The threads, extending the full depth of the cup inside, are half round and are therefore easily entered. In the grease cups with V-threads there is always the trouble to get the threads entered straight, especially after the cup has been in use for some little time. The finish may be according to taste or to the place where the greaser is used. The outside of the cup need not be machined at all, or it can be finished at little cost.

E. H. McK.

The English Apprentice and the American.

Editor American Machinist:

Is the apprentice of England or of the United States the better off after his term of apprenticeship is finished? Which one knows the most? Which can command the highest pay? These questions are of interest to every American machine shop owner, who should aim to bring out young workmen equal to and better than those of alien countries.

Of the American system of apprenticeship little comment is necessary. In manufacturing shops the main idea seems to be, what is the most profitable (for us) work that these boys can be put to?

A lad is taken on and the firm promises to teach him the "trade" in three or four years, as the case may be. But what is it that they really do? Merely make him an automatic addition to a machine, doing his part as the machine does its, till, when his apprenticeship is finished, he finds himself a lathe, miller or drill-press hand, as his luck happens. That's good for the boss all right to train up boys until they become reliable mechanical movements, but what of the boy?

Where is the lad that does not aspire to be superintendent some day, but how can he possibly do so and fill his place intelligently under present conditions? Can he be expected to direct work he does not fully comprehend? If he were a lathe hand and wished to know something of vise work, he might get the opportunity to do so on condition that he would consent to a reduction of wages which would put him on the same basis as a greenhorn, the explanation of this being "You wouldn't be worth so much to us."

The majority of repair shops prefer to hire men whom they can rely on in an emergency, and as there is not the same opening for cheap labor, the apprentice is usually left out.

Consider the English apprentice now: His term, if he is in the machine shop, is five years, and in the foundry seven. He will first be required to work about a year in the pattern shop and on going into the "black squad" will be put under the direction of a journeyman to learn all he can. A piece of plug or "bogie roll" is now useful as a means for obtaining tips, etc., for great is the power of a "chaw." The apprentices will in every probability be changed every six months or so as a matter of course, and will in some places finish up in the drawing room.

Then what is the result? He will most likely quit and hire elsewhere as an improver in whatever branch of the work he prefers and be able to make a pretty fair show at anything that comes his way.

The apprentice of the repair shop is usually very much in evidence here. He is pretty much his own boss and has his turn

on all work that comes in. The hight of his ambition when he first starts is to sit on a soap box and brush chips from the planer while it flutes a long roll.

The woolen and cotton mill shops give a boy the best all-round training he could get. He sees, as well as regular shop work, all sorts of transmission jobs. He doesn't misuse his spare moments and has lots of home-made tools in the workmanship of which he takes a pride.

Dollars or practical men—which shall it be? INSTIGATOR.

Chain Rings.

Editor American Machinist:

The formula and table for chain rings given by Frank B. Kleinhans on page 1314 of the AMERICAN MACHINIST make me tired. I infer he must be a technical student, and if so his instructors ought to be complimented.

The idea that ⅜-inch chain is made of iron exactly ⅜ inch in diameter, or that one ever buys iron for chain rings anywhere within a hundredth of an inch of 753 one-thousandths, and then further to go all thru that foolishness and not discover, if his table is correct, that the ring needs to be made of iron twice the diameter (which is always a commercial size) of the iron used for the links, is funny to say the least.

Then, again, who is foolish enough to suppose that the iron to be used in the ring will be so near the quality of the iron in the links (while in fact it is better if it isn't) that anything is to be gained by figuring down to the third place of decimals?

It was Agassiz, I believe, who said: "Dirt is material in the wrong place." Someone ought to coin a word to designate what mathematics in the wrong place is, as use could often be made of it.

JOHN E. SWEET.

Editor American Machinist:

It seems to me that Mr. Kleinhans' article at page 1314 has been left incomplete, in that he has not given us one of those handy little formulas which are near enough for practical use, and which are handy because of the ease with which they may be stored in the memory for future use. How many men who handle chains could even read the formulas on page 1314, let alone work them out?

There is a formula for obtaining the safe working strain in tons on a chain. It is a trifle safer than Mr. Kleinhans' table; but that is a good fault, I think, as chains are liable to deteriorate. I do not remember where I got this formula, but have used it many times within the last twenty-odd years.

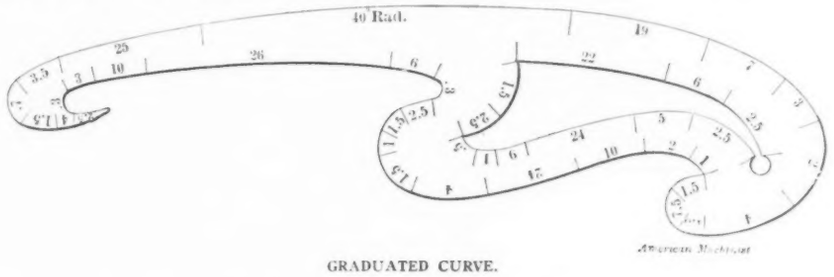
The diameter of the iron in the link in eighths, squared, divided by 8 gives safe working load in tons. Thus a ⅜ chain would be $3 \times 3 = 9 \div 8 = 1\frac{1}{8}$ tons, as against 1¼ tons by the table at page 1314. Five-eighth inch chain would be $5 \times 5 = 25 \div 8 = 3\frac{1}{8}$ tons, as against 3.97 tons in the table. This formula has the advantage that the average foundry laborer would have little difficulty in remembering it. DIXIE.

A Graduated Curve.

Editor American Machinist:

At page 1210 you show a graduated irregular curve which is certainly quite an improvement over the plain irregular curve. It seems to me, if the drawing is made full size, the patternmaker can easily enough reproduce the right curve on his work by the method described, but if the drawing is made half size, or quarter size, he would have his usual troubles to get the right curve because he does not know the radius. Of course if he was provided with a curve twice or four times the size of the one used by the draftsman, it would in such cases overcome the difficulty.

The enclosed sketch shows a graduated curve that I have used for some time with satisfactory results. Whenever I used the irregular curve on a drawing the patternmaker wanted to know the different radii that the curve was composed of in order to get the same curve on the pattern. This suggested the idea of marking the different radii on the curve. The arc from one line to the next is a part of a circle with the radius marked between these lines. It is an easy matter to mark the different radii on the drawing showing where each one starts and ends. Since I do this I have no more trouble with the patternmaker, and he does not need any curve at all. I have marked the curve "half size," since most of our drawings are made half size. If I use the curve on a quarter-size drawing, I mark the radius on the drawing twice the number given on the curve, and on a full-size drawing one-half of the number. H. I.



GRADUATED CURVE.

Editor American Machinist:

To the letter at page 1210, on "A Graduated Curve," I would like to add a few words. The use given is a good one; but a better plan for the average draftsman is to have the curve graduated alike on both sides, so as to be able to reverse it in order to put the same curve on each side of a center line. Most draftsmen, after drawing a curve, mark the curve on the edge so as to be able to reverse it, but the graduations are better.

HERMAN JONSON.

[This plan was proposed in our columns in 1881 by Prof. Sweet.—Ed.]

A New Arrangement of Slide-Rule Runners.

Editor American Machinist:

I note at page 1303 that Daniel Goldschmidt describes an addition to his slide-rule by which he says he greatly increases the rapidity of operations, and gives as an illustration the solution of $\frac{108}{3^3} = \frac{108}{27} = 4$. According to his method, this solution necessitates seven distinct operations. With my "Duplex" slide-rule I obtain the same result with but three distinct operations, as follows:

C. I.	Set 3	C	R to 3	108 to R	Find Answer 4.
D	To 3	D			Over 1.

which written out in full means: Place 3 on scale *C* inverted over 3 on *D;* turn the rule over and move runner to 3 on scale *C*, then move the slide to bring 108 to runner, when over right-hand index of *D* will be found the answer 4 on scale *C*.

It will be noted that the cube of 3 is obtained by the mere setting of the slide, the same being at once given on scale *D* below 3 on scale *C*. All that is now required to be done is to bring 108 on scale *C* over cube of 3 or 27 on scale *D*, and then at once read over right-hand index of *D* the answer. In most cases this could be done without using the runner at all, thus reducing the actual operations to two as against 7. WILLIAM COX.

Editor American Machinist:

With the "New Arrangement of Slide-Rule Runners" described by Daniel Goldschmidt at page 1303 he makes six settings to solve the problem $\frac{108}{3^3} = 4$. Without this new arrangement it is only necessary to make three, as follows: Set left-hand index of *C* to 3 on *D;* set runner to 3 on *B;* set 108 on *B* to runner; read answer 4 at right-hand index of *A*. To confine the operations to the lower scales alone, as Mr. Goldschmidt seems to desire, five settings are required for three separate divisions by 3, but this is still a saving of one.

E. D. MACKINTOSH.

There are indications in England of a revival in the iron and steel trades. Both in the Wolverhampton and Birmingham markets the tone is better; in the latter it is stated that the general condition of the iron trade is good, if not active. Pig iron is very firm, and steel is very largely in demand for building contracts.

The International Engineering Congress at St. Louis.

The meeting of engineers named above took place in the World's Fair grounds at St. Louis, October 3 to 8, inclusive, according to program.

The first meeting was a general one, held in the Hall of Congresses of the Administration Building, and was called to order by Henry S. Haines, chairman of the Committee on Organization, who briefly explained the origin of the congress.

The management of the exposition had invited the American Society of Civil Engineers to undertake the arrangements for such a congress and the society had then appointed a committee to confer with and secure the participation of the other national engineering societies. But "for some reason satisfactory to themselves" the other societies had declined to participate and therefore, the responsibility having been placed upon the civil engineers, they had determined to undertake it alone. The result, so far as contributions of professional papers is concerned, was declared to have been entirely satisfactory—papers having been received from all parts of the world.

Mr. Haines introduced Charles Hermany, president of the American Society of Civil Engineers, who spoke at considerable length, reviewing the work of engineers generally and its importance, especially in connection with the development of the territory of the great Louisiana Purchase and in the construction of such an exhibition as the one now being held to commemorate it.

President Francis of the Exposition company, who was to have delivered the address of welcome, having been kept away by the death of a relative, Director of Exhibits F. J. B. Skiff, tho acting upon very short notice, performed that function in a very acceptable manner. Particularly referring to such congresses, he said:

"The exposition in a material sense will pass away to-morrow, in a day, and the memory of contemporaneous people will sustain it as a record for only a short time. But the record of the thought that created the exposition, not referring to the management, but the record of the thought thru which these material evidences of man's condition and society's condition at this time—that record becomes an asset that will build and sustain the ages."

Sir William White, president of the Institute of Civil Engineers of Great Britain, then spoke, referring particularly to the work of engineers in connection with shipbuilding. His address was very felicitous and filled with the spirit of good fellowship. During its course he referred naturally to the America Cup, and concerning this said:

"I like to think on this occasion how one nation helps another, not merely how one department of engineering helps another, but how one nation helps another. We in England have grown to be the great shipbuilders of the world. We are proud of it. We claim it, we know we hold it, and we intend never to sacrifice it as long as we can hold it; but we do not forget that we owe our knowledge of the theory of naval architecture to our French brothers. The French in theoretical investigation were leaders, and they to-day remain in the forefront of investigation, and we who learn so much from them and who now endeavor to equal them on the theoretical side, I think, in our turn have been able to give some service in the department of the practical art of shipbuilding. And so in America. Take, for instance, the 'America' cup. Everybody knows that the 'America' which took the cup was designed by a gentleman by the name of Steers, who was born in the United States. That you all know. I am bound to say you can all tell me that; but I wonder if you all know, as I do, that the Mr. Steers who designed the 'America' was born a week or two after his mother landed here, and that his father was born in my own little town. I will now leave it to you to say how much claim we have on Mr. Steers, and I shall not enter further into that discussion."

Referring to his own work as chief naval constructor for many years, he said that under his direction $500,000,000 had been spent in the construction of naval vessels, and he argued that this expenditure had tended toward the preservation of peace and had prevented wars.

The chairman then called upon other foreign delegates, and Messrs. Loicq de Lobel, of Paris; Oswald Ehrlinghagen, of Germany; L. A. Huergo, of Buenos Ayres; B. Bachmetew, of the Polytechnich Institute of St. Petersburg, Russia, and Otto F. Schoszberger, of the Imperial Technical High School of Vienna, Austria, responded, each briefly, and most of them in English. Some announcements by the secretary, G. W. Hunt, closed the session, there having been, perhaps, 300 in the audience.

Tuesday morning at 10 o'clock was the appointed hour for meetings of the various sections, as follow:

Section A—Waterways.—Alfred Noble, Past President Am. Soc. C. E., Chairman.

Section B—Municipal.—J. James R. Croes, Past President Am. Soc. C. E., Chairman.

Section C—Railroads.—Robert Moore, Past President Am. Soc. C. E., Chairman.

Section D—Materials of Construction.—Frederic P. Stearns, M. Am. Soc. C. E., Chairman.

Section E—Mechanical.—William Metcalf, Past President Am. Soc. C. E., Chairman.

Section F—Electrical.—Frank J. Sprague, M. Am. Soc. C. E., Chairman.

Section G—Military and Naval.—William P. Craighill, Brig.-Gen. U. S. A. (retired), Past President Am. Soc. C. E., Chairman.

Section H—Miscellaneous.—Octave Chanute, Past President Am. Soc. C. E., Chairman.

At the appointed time there had gathered in Section E five people, including one lady whose husband was to present a paper, and Chairman Hermany, who presided in the absense of Mr. Metcalf, who, it was announced, was unable to be present. By waiting half an hour thirteen people were present, and, finally, before the meeting adjourned there were about twenty present, some probably being prevented from attendance by the always difficult task of finding and reaching a given point in the exposition not of general popular interest and that everybody knows all about. In opening the meeting the chairman referred to the very small attendance, but in inviting those present to participate in the discussion, said that it was evident from the subscriptions received that those who might speak would reach, thru the published proceedings of the congress, a very large audience, and one which extended all over the civilized world.

PURIFICATION OF WATER FOR THE PRODUCTION OF STEAM.

This paper, by J. O. Handy, chief chemist of the Pittsburg Testing Laboratory, was presented by the chairman, in abstract. It deals with the subject of boiler water purification from the chemist's standpoint almost exclusively, his treatment of mechanical methods of purification occupying three-quarters of a page out of a total of thirty-three pages in the paper. Under this head it is stated that "schemes for heating boiler feed water under pressure before passing to the boiler have never passed the experimental stage, owing chiefly to the imperfect precipitation of scale-forming substances by short exposure. Sulphate of lime deposits as scale in boilers very gradually with increasing concentration. Pressure and temperature have a modifying influence on the rate of deposition, but no temperature is reached in steam boiler practise at which sulphate of lime immediately falls out of solution."

The paper then reviews and describes the various chemical methods that have been used, and, dealing almost entirely with locomotive practise, makes out a good case for chemical treatment, in the points of improved service from locomotives, lessening of repairs to boilers and increased fuel economy; stating, however, that the falling off in fuel economy by reason of scale is not always as great as would be expected by any means, and giving instances where in the case of very porous scale the loss was inconsiderable. The paper referring to the utility of stirring apparatus used in the so-called continuous method of chemical purification and the tendency of water to foam when it has been treated by alkaline re-agents,

the chairman suggested that discussion might at first appropriately be confined to those points.

Ferdinand Kraus, manager of the Nans Reisert Company, of New York city, read a written discussion of the paper, in which he dissented very decidedly from many of the statements made in regard to the utility and practicability of certain chemical processes, his discussion being mainly an argument to sustain the practise of his company, which he in effect declared was successfully doing many of the things declared by the author to be impracticable.

A. McGill, of Ottawa, Canada, a chemist connected with the Canadian Pacific Railroad, spoke strongly advocating the intermittent system of chemical treatment, which he said is the only one that takes account of the fact that it requires time to form a clear chemical solution, and that if undissolved particles are floating in the water they become covered with a practically insoluble coating by which they are protected from further action and from being acted upon. Speaking of foaming, Mr. McGill did not profess to be able to explain its cause, but he was disposed to ascribe it to a lowering of the surface tension of the water by the solution of soda salts. He described some experiments made by him, in which he constructed a small boiler, arranged a safety valve at the top of the tube, which tube could be moved vertically to or from the surface of the water in the boiler. He had set the valve to open at 5 pounds pressure, had then held the valve down until the pressure was 10 pounds, and suddenly released it; the lower end of the tube being within ½ inch of the water, which was distilled. There was no foaming, but only dry steam came thru the valve. Water containing finely powdered chalk gave the same results, but with water containing 1,500 parts of soda per million there was violent foaming under the same conditions. He believed no water containing that amount of soda can be boiled without producing a similar result. He spoke of the difficult problems presented by some of the waters with which some of the Canadian roads had to deal, and expressed the belief that barium offered most promise of a successful means of treating such waters. At present no available supply of barium was known to exist, but he hoped it would be found either in Canada or the United States.

Fred J. Miller called attention to the statement made in the paper regarding the purification of feed water by steam under pressure before passing to the boiler, which statement has been quoted above, and called attention to the fact that there is, and has been for years, a system for doing this (the Hoppes), which in the case of some bad boiler waters at least and for stationary plants was entirely successful and satisfactory. He thought, therefore, the statement referred to was entirely too broad to be accurate. In response to an inquiry by the chairman, he said he did not know of the system having been applied to locomotives or to any service except that of stationary boiler plants, where the heat imparted to the water is nearly all immediately returned to the boiler with the purified water, and not wasted, as of course it would be, in the case of locomotives or for other service where the water is not to be immediately passed to the boiler.

Locomotives and Other Rolling Stock.

Under this title M. Edouard Sauvage, Chief Engineer of Mines and Professor in the School of Mines of France, gave an account of recent French locomotive construction, especially of the balanced four-cylinder compounds, his paper being mainly a repetition and reinforcement of the claims made for these engines in his paper read before the joint meeting of British and American Mechanical Engineers in London in 1900; experience with the locomotives in the interim showing that the claims then made were well founded.

The advantages of the four-cylinder compound system, as resulting from a prolonged practise in France, may be summed up as follows:

Economy of coal resulting from the compound system in itself, or increase of power with the same consumption of coal.

Good utilization of steam at very high pressure, with the simple or piston valve and the old gears.

Good balance of pistons and other pieces with reciprocating motion; counterweights applied only for revolving parts, thus doing away with vertical variations of pressure and pounding action on rails.

Ample bearing surfaces for all parts of mechanism, owing to the use of four cylinders with four separate gears and suppression of all undue strains.

It must be added that these compounds possess great elasticity in working, and are as well fitted for moderate as for high speeds, for light or for heavy trains. They remain economical within a wide range of power.

Another paper, by William Forsyth, mechanical engineer of *The Railway Age*, dealt with

American Locomotives.

The paper is largely descriptive, and gives first the principal dimensions of representative American passenger and freight locomotives at the time of the Chicago Exposition in 1893. Since that the wheel arrangements have changed materially and an explanation is given of those used at the present time, the names of the different types and the reasons which led to their use. The four-cylinder balanced compounds are described, and the ones designed by the Baldwin Locomotive Works and the American Locomotive Company are compared with the Von Vorries type and the De Glehn type. It is shown that for freight service the consolidation engine remains the favorite type, and illustrations are given of fine examples of that type of engine. For mountain grades and pushing engines the decapod and mastodon types are used, and large engines of those kinds are illustrated and described. An illustration is also given of an anthracite consolidation engine on account of the different shape and size of the firebox used for this fuel, and also on account of the change in the appearance of the engine, due to the location of the cab over the barrel of the boiler.

In boiler design the principal change since 1893 has been the use of a barrel of much larger diameter and tubes as long as 20 feet, and the general use of the wide fireboxes extending over the driving wheels of all large engines. In the spacing of the tubes it is shown that in the effort to obtain a large amount of surface they are crowded too close together in many large boilers, leaving the bridges only 5/8 inch, and experience with such boilers has shown that the circulation is so bad that an equivalent evaporation can be obtained with fewer tubes spaced further apart, and the tendency now is to use 3/4 or 7/8 inch spacing.

In connection with the operation of large locomotives in America it is found that the amount of coal to be handled per hour by the fireman is so large that only very strong men are able to endure the work and keep the grate covered uniformly during the whole trip. Many firemen are not equal to this task and the result is that the full steam pressure is not sustained, the power of the engine is reduced, the time on the road is prolonged and the boiler, subjected to unequal temperature, soon begins to leak at the tubes and firebox. There is suggested as a remedy the automatic stoker, and the Day stoker, which is now in successful operation, is recommended for large engines and some description of it is given.

Piston valves are now quite generally used on American locomotives. They were introduced because they were more easily handled on account of less friction, but it has been the general belief that they leak more than the flat valves and more difficulty has been found on account of water in the cylinder not being allowed to escape as it does by raising the flat valve. Recent tests by the Master Mechanics' Association have shown that there is greater loss due to leakage in flat valves than there is in piston valves, and that if equal care is taken to maintain the packing rings of piston valves less leakage will be found from them.

Under the head of Valve Gear, the increasing weight of the parts of the valve gear on American locomotives is pointed out, and it is thought that a considerable disturbance in the steam distribution is

caused by the destructive effect of the heavy valve motion and its rapid wear and tear, resulting in irregular distribution. The Walschaert valve motion as used on the Baltimore & Ohio Mallet articulated engine is illustrated, and this type of valve motion is suggested as one which could be used to advantage in American practise.

Under the head of Locomotive Frames, it is shown that the bar frame is still used extensively in American practise and that it does not seem feasible to adopt any other form on the general design of American locomotives, altho for trailing wheels of the Atlantic and Pacific types plate frames have been used for back connection. The trouble from broken frames still continues, but the cause does not seem to appear to be understood and no successful remedies have been suggested. Cast-steel frames are used to a larger extent than forged ones and a specification is given for the quality of the steel to be used for such purposes.

In regard to the performance of American locomotives, it is unfortunate that very few accurate tests have been made with large modern locomotives, and for results of such tests the members are referred to the reports of the work now being done at the Pennsylvania Railroad's locomotive testing plant at the Transportation Building.

There seemed little inclination on the part of those present to discuss the papers, tho urged to do so by the Chair. Finally, however, Karl P. Dahlstrom, of Stockholm, Sweden, referring to the fact that the subject under discussion extended to other rolling stock besides locomotives, took up the cudgels for the European style of sleeping car and expressed his dislike of the American or Pullman style, saying:

"Those of you who have traveled in Europe know that the style of carriage used for night service in Europe is a long corridor passing along the side of the car or carriage, and from that corridor there are apartments composing the sleeping rooms. Those compartments sometimes contain four berths, sometimes two berths, and in some cases, in very first-class service, only one berth—or they use only one berth. Now with that arrangement of the compartments there is a much more convenient plan of distributing the passengers in the car. Every passenger can get much more privacy and comfort. He is not at all troubled by all this making up of beds that they have in Pullman cars; and when the car is used in the day service there is of course not the large American salon car that you have here, but a car that will hold in private compartments those who wish to associate together. I think that in the Pullman car the making up of the beds takes at least four times as long as it does in a European style car. It would interest me very much to know if there are any of those present who could explain to me why in the American practise—the Pullman practise—they adhere to the present arrangement of the car when there are such evident advantages in the other arrangement, the European arrangement. Now, if anyone of you has traveled in Sweden, you can give evidence as to the excellent quality of the cars for this service that are built there. I believe that the Swedish cars by far excel the Continental cars, both English and French, and also the German cars, as regards the commodious arrangements for night traveling.

"Now, the point I would like to inquire about is if anybody present could give information as to why this European style has not been tried, or why it should not be suitable in the American railway passenger service. I am sure it would greatly contribute to the comfort of travelers in this country with its very large distances."

The chairman, who as general manager of the Plant System for many years had had much to do with the construction and use of sleeping cars here and had also traveled abroad, defended the Pullman, saying that it seemed better adapted to American democratic ideas and that the style of car described by Mr. Dahlstrom had been invented here in America, was known as the Mann Boudoir bar, had been gotten up simply to get around the Pullman patents, but had not been popular or successful here. He said that Mr. Mann took it to Europe, where it had suited the tastes of the people better than here and had been adopted. Personally, he did not like it so well and he did not believe that Americans generally did, or would.

SESSION OF WEDNESDAY, THE 5TH.

The session of the mechanical engineering section of Wednesday, the 5th, was called to order at 10.35 A. M. with about the same attendance as on the previous day. As before, Chairman Haines called attention to the fact that speakers were really addressing a very large audience and one by no means confined to the four walls of the small basement room in which Section F was holding its sessions. And certainly the remarks of the chairman were timely and appropriate to the situation, for the small audience (thirteen at the opening) who sat at the back of the room behind an array of empty chairs near an open door thru which came the sounds of the voices of visitors to the Anthropological Building, with occasionally a few of the owners of the voices, who gazed about the walls at the life-sized and colored pictures of specimens representing the various races of men, evidently thinking we were students and professors of that science, made it seem like almost anything else rather than a meeting of a portion of a great international engineering congress.

The first paper of the session was upon

TURBINES AND WATER WHEELS.

It had been prepared by Prof. Gardner S. Williams, of Michigan University, who was present, and in presenting the paper gave an abstract of it substantially as follows:

"I feel deeply indebted to the manufacturers for *promises* of valuable information bearing upon this subject. As evidently more lucrative opportunities for effort were open to them in the rush of business incident to a busy season, I was unable to get more than a very few suggestions from the wheel manufacturers, altho I tried faithfully to gain more information from them upon the historic side of the question.

"The matter of tests of American turbines has been gone into with some considerable minutiæ by reason of the fact that from time to time there appears in the technical press, or elsewhere, various slurs upon the performances of American turbines. Sometimes these simply take the form of questions as to whether the efficiencies of these wheels that are claimed have actually been attained, and sometimes go further and state positively that it is impossible that they have been attained. Not long ago a writer in an engineering journal stated quite positively that the American turbines were nothing more than cut-and-try apparatus, and practically said that it was impossible to apply scientific treatment to their performances; that American wheel builders seemed to be incompetent to apply their wheels to meet definite specifications. Of course, any investigation of the methods of testing American turbines involves a good many elements, principally as to the measurement of power, the measurement of head, and the measurement of the quantity of water; and in the discussion presented of the measurement of water there are some experimental results given, and some comparisons which have not appeared elsewhere. Probably the most important and the most interesting part is to be found in the table on page 26, where there is a comparison for which a great many engineers have been looking—that is, it is a comparison of different formulas for the flow of water over weirs with an idea of determining what their differences or what their agreements are. A brief word of explanation may be proper at this place, altho the matter is gone into quite freely in the text.

"Mr. Francis, whose formula is very generally used in the United States, made use of three methods of measuring or observing the head upon the weir. He made use of an orifice in the side of his canal, about 6 feet up stream from the weir, and pretty nearly at the level of the bottom. He made use of an orifice 6 feet up stream from the weir and near the bottom (about a foot above the bottom of the channel), and he made use of an orifice 6 feet up stream from the weir, and in the bottom of the channel, but out near its center. Those three devices have been repeated, and the observations of heads taken simultaneously, as reduced from a long series

of simultaneous observations on each, have been presented in the paper.

"Messrs. Fteley and Stearns made use of a device quite similar to the first—that is, an orifice 6 feet up stream from the weir, and quite similar to the plank orifice. The gist of the whole matter is summarized, in which it appears that for this range of head from .5 to 4 feet, the differences in the formulas making use of the devices used by the originators of the formulas is within 5 per cent. thru the whole range; so that either the Bazin or Fteley and Stearns formula is entitled to equal credence up to a head of 4 feet, and we may give the Francis formula the same credence up to 2 feet. Mr. Francis did not intend that his formula should be used at a head higher than 2 feet. He distinctly says that its range is supposed to be from about 0.5 of a foot up to 2 feet. Of course, as you go to the lower heads, all weir formulas become more or less erratic, and special formulas have to be deduced when it gets to very low heads."

Referring to the results shown in certain tables in the paper the author said that a pair of similar wheels, one right hand and the other left, had shown the same efficiency "within less than half of one per cent. I think that is most excellent testimony, as to the accuracy of the investigation by the Holyoke testing crew, and, I think, should do away with the criticisms that are sometimes being at least suggested that their methods were what is sometimes termed as 'sloppy.' My feeling is that the experimentation at Holyoke is of a most thorough and reliable character, and it is only a very rare occurrence that what may be called 'an error of manipulation' creeps in. Another point that this table brings out is the difference in the performances of wheels in warm and in cold weather. Wheels first tested in August were tested again in January, and the efficiency fell off nearly 2 per cent. That result was so startling when it was obtained that a very careful examination of all conditions was made by the contractors, by the engineers testing the flume, and by myself representing the purchasers; and we came to the conclusion that there was nothing to indicate—we were unable to find any source of error in those tests. We were not willing at that time to attribute this discrepancy to the difference in temperature, and thought there was a possibility perhaps that something had escaped us in the earlier tests in August, 1900; and it was not until some of the wheels were reinstalled in August, 1901, under practically the same conditions of temperature, and with all other conditions made as nearly the same as it was possible to make them, as they were in the original tests, and this test resulted in duplicating within less than half of one per cent. the original performance in August, 1900, that we were prepared to say that the explanation seemed to be that in cold weather water does not flow thru the wheels so freely, or over the weir so freely, as it does in warmer weather. It was a case of working against the wheel at both ends. Not only does the weir have to overcome the additional resistance in itself in the passage of water at the lower temperature, but it also has to overcome an apparent debit by reason of the fact that it takes a higher head. Probably in cold weather there is not the same quantity of water flowing over the weir that there is in warm weather. I might say in connection with this that an examination was made of other tests of wheels where wheels of the same kind had happened to be tested in the Holyoke flume in both cold and warm weather; and in the few cases where it was found possible to locate instances of that kind, all of them showed a lower efficiency for wheels in cold weather than had been obtained in warm weather.

"As to impulse wheels, the conclusions are practically to the effect that we may get 99 per cent. of efficiency from the nozzle; probably 97 or 98 is more nearly what we are likely to obtain. The Pelton buckets appear to give 90 per cent. How much higher efficiency can be obtained from other forms of buckets will have to be a matter of experiment."

Tho the paper seemed to be practically an almost unqualified endorsement of the Holyoke tests and methods of testing, it was evidently not sufficiently so to suit those who are doing the work, as was shown by a written discussion sent in by Clemens Herschel and A. F. Sickman, in which discussion they said, in part:

"We have read the article entitled 'Turbines and Water Wheels,' under cover of which title the author attempts in twenty-six out of a total of thirty-eight pages, to damn with faint praise the twenty-three-year work of this testing flume, and may say at once to our Civil Engineer friends and to the public, that the work of the testing flume which has hitherto received the universal approval of all engineers except the author of the article referred to, will continue on the precise lines followed from the beginning of that work to date, and until it is shown by actual admeasurements to be erroneous—which this article on turbines and water wheels does not do.

"It has, of course, been gratifying to have this long-time work of the flume receive endorsement, on account of all of its apparatus and methods, except the one of the mode of observing the hight of water upon the weir, no matter how or whence such endorsement came, and we would welcome at any time the pointing out of any method by which still greater accuracy may be attained; but as we can speak on the subject that has been attacked, and on much other of the subject matter of the paper under review, at first hand, where this paper is necessarily, on account of the confessed practical inexperience of its author, relegated to a recital of data obtained at second and at third hand, followed by argumentation based on data thus obtained, we have not found any reason to depart from the established apparatus and methods of using it."

They then go on in an effort to show that Mr. Francis must have known all about weirs and water-wheel testing; that they themselves have absorbed all his knowledge and applied it to the work done there, which must therefore necessarily be above criticism, and that the author of the paper is presumptuous in attempting any such criticism. The language in which they do this is, however, for the most part a little wabbly and uncertain, and we cannot attempt to reproduce or interpret it. Suffice it to say they are evidently much annoyed at Mr. Williams, tho just why, is difficult to understand.

A gentleman from California presented some oral discussion of the paper, in which he gave some data regarding the efficiency of impulse wheels; but this, owing to the utter failure of the official stenographer to deliver a report of the meetings, as he promised to do, we are unable to present at this time.

Passenger Elevators.

The above was the subject of a paper by Thomas E. Brown, in which he goes over the history of the development of passenger elevators and describes the principal features of the different classes. The paper is, however, more than this, as it includes some analysis of the different types and some of the reasons of their successes and failures, with formulas for proportions of certain parts. Speaking of high-pressure elevator plants, the author says:

"In general, these high-pressure plants were not successful. They fulfilled all that was expected of them as lifting machines, and in economy of operation; but the high pressures used necessitated extremely small pilot valves, in which it was difficult to maintain the packings, and which, when not packed, involved too great a loss by leakage, and hence were difficult to handle, a slight variation in the condition of the pilots destroying the adjustment of the operating devices. Also, the necessarily small appertures in the pilots were readily clogged by shreds of packing. Hence they fell into disfavor, and in some instances were removed and other types installed in their places.

"These difficulties led elevator builders to give attention to the improvement of the low-pressure types, in the endeavor to attain the same economies accomplished with the high-pressure, and yet retain the simple construction of the old standard types, and in 1896 plants were installed in the Bowling Green and St. Paul Buildings, and in 1898 in the Standard Oil Building, in New York city, in which, instead of arranging the machines themselves to be of varying power, two pressures were supplied: low pressures, suited to the average loads to be carried,

and which were usually from 100 to 120 pounds; and high pressures to suit the heavier loads which were from 180 to 200 pounds. A special form of controlling valve was used by which either the high or low pressure could be admitted to the cylinder, as required.

"The use of this system developed an advantage, which had not been foreseen: Even when the cylinder was connected with the high pressure, unless the load in the car required this high pressure, a portion of the low-pressure water was taken into the cylinder by the injector action of the high-pressure water moving at high velocity thru the valve, so that the consumption of power was adjusted automatically to the requirements of the actual load in the car.

"At the Bowling Green and St. Paul Buildings, the primary or low pressure was produced by Worthington direct-acting triple-expansion pumping engines. The higher pressure was produced by a 'booster,' which was an ordinary direct-acting compound duplex pump, taking suction from the low-pressure system, and boosting to the higher pressure. By this arrangement all the water used was pumped by an economical engine to the lower pressure—the pressure generally used. The booster having to do only the occasional work, and only performing the difference in work between the low and the high pressure, could be of smaller dimensions and of a less expensive type."

The author strongly condemned what is known as the plunger elevator, saying it had been highly developed in Europe and used there extensively, and here as well, for heavy freight and short lifts, but that "it was introduced and is being used to-day to an extent not warranted by its actual merits. In the mind of the public, such a machine seems safe, in that the car is supported from underneath instead of being suspended, and this has inspired such confidence that these machines are usually installed without any safety devices whatsoever. With the high speeds and high rises usual to-day, this sense of security is not justified.

"The mechanical efficiency of this machine is very high, nearly 90 per cent.; but its net efficiency for high rises and high speeds is low, on account of the large amount of unbalanced weight required to bring the moving masses to rest.

"The advantages of high-pressure elevators, namely, low percentage of hydraulic loss, admitting of high speed with reasonable sizes of valves and pipes and maintenance of speed close to the limit of the lifting capacity; greater economy, due to the reduction of hydraulic losses, especially where power is distributed over large distances; saving of space, etc., caused elevator builders to give great study to the one defect, namely, the pilot valve. But no important success was reached until Mr. H. F. Witte, of Chicago, hit upon the simple expedient of abandoning the high-pressure pilot valve and operating the high-pressure controlling valve by a low-pressure piston and pilot valve, taking pressure from a separate system.

"This at once solved the problem, as it eliminated the one objectionable feature, and substituted the well-known low-pressure pilot, which had been in successful use for many years.

"Mr. Witte also hit upon the expedient of using the pressure from this discharge reservoir for the operation of the pilot-valve device. Thus the system required a separate system only in part, *i. e.*, a line of pipe to carry the discharge from the pilot cylinders back to the engine-room. A special small pump was placed in the engine-room to return the water discharged by the pilot valves to the main discharge system.

"High-pressure elevators at once came into use again.

"When Frank J. Sprague became interested in electric elevators he introduced the system of "car-mile" comparison, borrowed from electric railway practise, and it has become customary to compare elevator systems by the horse-power-hours, kilowatt-hours, or pounds of steam consumed per mile run by the elevators. Such a comparison, made without reference to the lifting capacity, speed, or load carried, is as valuable as a comparison of two engines by the pounds of steam consumed per revolution, or of two motors by the current consumed, without reference to their power or the effective work done by each. Nevertheless, it is a convenient comparison of plants designed for similar duties in buildings of similar character of service; and it is useful in estimating fuel consumption for any given plant when the car-mileage is known or can be assumed. A good average for general office service is 15 car-miles per day per elevator, tho in some buildings not more than 12, and in others as many as 20 car-miles are made.

"Centrifugal pumps driven by direct-connected electric motors have been used in a few instances. Heretofore the inefficiency of such pumps has precluded their use; but, with the improvements now being made, it is probable that they will come into extensive use in the future, as efficiencies of more than 70 per cent. have already been attained, and there seems to be no reason why such pumps cannot be made to give still better results.

"It has already been proposed to use centrifugal pumps direct connected to steam turbines for elevator service, and there is no doubt that this form of pumping apparatus will come into use for such service in the near future."

The credit of having designed and built the first direct-connected electric elevator actually installed and used in a building is given by the author of the paper to William Baxter, Jr., who installed such an elevator in 1887. In general, however, the author does not approve of electric elevators except for special service.

Speaking of worm-driven machines, the author says:

"Experience shows that under the conditions of elevator service the allowable pressure at the pitch line of a worm and wheel should not exceed 2,500 pounds with the worm running in oil. It is true that for a short period of time a higher pressure may be used, but, in elevator service, any great excess of pressure above that named results in undue heating and wear, and the likelihood of cutting the worm and gears. Hence, the load which can be lifted by a single worm-wheel is limited by this condition. A double worm, with right- and left-hand threads, driving two interlocking worm-wheels, thereby balancing the pressure on each, can carry double the load of the single worm."

Referring to the safety of elevators and devices for rendering them safe, the author says:

"Tests have shown that a strong, healthy person, when descending at speed, may be stopped at a distance of one-fifth of the velocity hight without serious injury. This means increasing the strains upon the members of the body to six times the normal strains due to the individual's own weight. Manifestly, persons of delicate structure could not stand such a strain without serious injury, and, in good elevator practise, it is customary to arrange the safety devices to produce a stop about equal to the velocity hight, thus doubling the strains on the members of the body, strains which a person of the most ordinary physique can sustain without injury or serious discomfort.

"To accomplish this the retarding force of the safety devices should not exceed twice the weight of the car and load. The arrangements by which the safeties were operated by breakage of the cables, are now generally abandoned, and modern devices are operated by speed governors set for a predetermined speed, usually from 30 to 50 per cent. in excess of the designed speed of the elevator. If, from any cause, the speed of the car reaches that at which the governor is set, the safety devices are put in action and the car brought to rest."

Finally he said:

"It is estimated that the number of passengers carried daily by elevators in the city of New York exceeds the number carried by all the surface and elevated railways, and it speaks well for the excellence and safety of these machines that so few of these millions of passengers are injured.

"The elevator, looked upon forty years ago as a luxury, has now become a necessity, and, from installations costing a few thousand dollars, has grown to single installations costing half a million. The installations of passenger and freight elevators throughout the United States dur-

(*Continued on page 1383.*)

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

World Building, New York.

Also Published at 6 Bouverie Street, London, E. C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, World Bldg., New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by all newsdealers generally.

The AMERICAN MACHINIST Co., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 25 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *17,100 copies are printed. Total for 1904, so far, 837,350. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

Contents.

	PAGE
A Simple Dynamometer	1357
Dimensions on Drawings	1359
A New Sand-Blast Apparatus	1360
Alcohol for Motors—I	1362
Locating Dynamo and Motor Faults	1364
Electric Drive for Fire Pumps	1365
Industrial Education in Germany—VII	1365
Machining Gear Blanks on a 30-Inch Vertical Boring Mill	1367
Opportunities of the Engineer Graduate	1367
Letters from Practical Men: That Jack-in-the-Box Speed-Changing Device....Cam Milling Tools....That Sketching Device....A Facing Cutter....School Drawings....A Small Milling Fixture....A Grinder's Troubles....A Draftsman's Reversible Triangle....Stealing Men—"Help Wanted" Advertisements—A Foreman's View....A Home-Made Portable Bench....A Threading Tool for the Turret....A Simple Method of Proving a Multiplication....The Accident to the "St. Louis"....Variable Speed Countershaft	1369-1376
The International Engineering Congress at St. Louis	1377
Modification of English Patent Office Practise	1382
Opposition to the Premium Plan in Great Britain	1382
International Congress of Mines and Metallurgy	1383
Some New Things	1383

Modification of English Patent Office Practise.

For many years the introduction of the system of official examinations of applications for letters patent in Great Britain has been discussed, and a new law providing for such examination goes into effect January 1 next. There are, however, several important differences between the new English practise and that of our own and the German Patent Offices. Thus the examination is to extend back only fifty years and is to apply to British patents only. More important, however, than this is the fact that in cases in which inventions are found to be anticipated, the Patent Office has no power to refuse the grant of patents. The object of the examination is to inform the inventor of the state of the art, but to leave to him the responsibility of saying whether the patent shall issue as at present; in other words, the government makes the examination which the inventor is now supposed to make for himself. The English patent authorities find great and not unreasonable objections in lodging with the examiners of the Patent Office the right to refuse to issue patents, and they cite cases of inventions which subsequently became of the highest importance, but for which patents were refused by the German Patent Office, in which the examination is particularly severe and in which the examiners have the absolute right to refuse a patent. In this country we believe the refusal of a patent, even after appeal to the Commissioner of Patents, is not final, the inventor still having recourse to the courts open to him; but this is seldom made use of, and, practically speaking, the refusal of a patent by the Office is final.

After a citation showing an anticipation of an invention, the inventor is expected to amend his claims as he now does here, but still he need not do so if he regards the citation as improper or unjust. The public is, however, safeguarded by a further provision, that in case the amendment is not made or is not satisfactory, the Office may insert in the patent references to such prior patents as are considered to be anticipations. The patent will thus carry upon its face citations, which are presumably good, by which such portions of the claims as are likely to be sustained in the event of a suit can be learned, and at the same time in the event of an unjust citation the inventor has his patent, which the courts will presumably sustain.

The new practise has much to commend it. We are not of those who regard our existing patent practise as the concentrated wisdom of the ages and we are well aware of the necessarily imperfect results that often attend the official examination, and of the danger that lies in making them in any sense final. At the same time the errors are much more apt to be on the side of undue laxity than undue severity. Many worthless patents are issued because the office fails to discover anticipations; but cases in which patents are unjustly refused are, we think, rare. It may still, however, be true in many cases that while an inventor gets his patent, it may still be emasculated by narrowing the claims under the insistance of the Office to an extent that deprives the inventor of much of the protection to which he is entitled. He has no defense against such action by the examiner, except to refuse to narrow the claims and then, after refusal of the patent, to appeal in succession to the examiner in chief, the commissioner and the courts, and sooner than do this he no doubt sometimes accepts what the examiner will give him, even tho satisfied he is entitled to more.

The new English plan would seem to safeguard both the inventor and the public—the former by pointing out the limitations by which his claims should be drawn, and the latter by stopping the practise of issuing patents which are known to be worthless, but which show no signs of the fact upon their faces, while the Patent Office is not allowed to exercise judicial functions which do not properly belong to it.

Opposition to the Premium Plan in Great Britain.

For nearly two years the members of the Amalgamated Society of Engineers of Great Britain have been working under an agreement with the Employers' Federation which provides for the use of the premium plan. The results have been so satisfactory that the employers have sought to extend the application of the system to work which is not included in the scope of the Amalgamated Society, and as a result the Engineering and Shipbuilding Trades Federation, comprising some twenty-four unions, appointed a committee to consider the subject. The report of this committee has just been made public and it is an unqualified condemnation of the system. Among other things the report says:

"The premium system has absolutely nothing to recommend it; it is an adaptation of the most pernicious and degrading condition of employment in modern industrial history—the task-work system; it creates jealousy and ill-feeling in the workshop, and is the cause of endless bickering and misunderstanding, owing to the complicated and intricate character of the calculations involved in many of the systems. It has been the cause of more men being discharged than any strike which has ever taken place in the history of the engineering or shipbuilding trades, and it will have the effect of keeping men, whose waning physical powers unfit them for the closest and hardest labor, from obtaining employment, except when trade is at its busiest."

Our knowledge of the report is limited to what we have seen of it in our English exchanges, which devote considerable space to it, but it does not appear to be

in all respects consistent. Thus, coupled with the statement that it is a task system and that it has been the cause of the discharge of many men, goes the statement that it has not resulted in increased efficiency. The idea in the author's mind was apparently that men had been discharged because the increased output due to the system had made their services superfluous, while the statement that it has not resulted in increased efficiency says the exact opposite. Meanwhile, the members of the Amalgamated Society continue to work under the system and, so far as indications go, to be satisfied with it and with its results. If this condition continues, it can hardly fail in the end to bring other unions in allied lines of work to conclude that the system is not the ogre which their imaginations have created.

It is proper at this time, altho it should hardly be necessary, to call attention to the courses of free evening lectures conducted by the Board of Education of the City of New York. For the season now beginning courses have been arranged in Astronomy, Biology, Physical Geography, Electricity and Physics. The lectures are by able and eminent instructors in their several specialties and are all illustrated by experiments or stereopticon. The lectures are not for children, and in fact children are not admitted, but are full of interest and information for adults of all classes. They are well and increasingly attended. Those interested will have no difficulty in obtaining the necessary information as to times and places. The full program is much too long for us to reproduce.

It has been customary to speak of the internal commerce of the United States, the absolutely free trade among its forty-five commonwealths, as equal to the entire international commerce of the world. It appears, however, to be double that, according to statistics of the Department of Commerce and Labor. The annual exports of all nations, according to the latest reports available, amount to $10,515,000,000 and the imports to $11,809,000,000, making a total of $22,324,000,000. By this addition of exports and imports the transactions are of course counted twice, while in stating the internal commerce of the United States the transactions are only reckoned singly and then they show a total of $22,000,000,000. This estimate is formed by taking the census valuation of the manufactures, agricultural products, products of the fisheries, forests, mines, etc., and adding thereto the cost of transportation between producer and consumer.

International Congress of Mines and Metallurgy.

An international congress of mines, metallurgy, mechanics, and applied geology is to be held at the time of the international exposition at Liège, Belgium, next year. It will open June 26 and end July 1. The section of applied mechanics will be subdivided as follows: (1) Machine design; (2) internal combustion motors; (3) mechanical applications of electricity; (4) (4) turbo-engines; (5) steam engines and boilers; (6) auto-trucks. Information may be obtained from Henri Dechamps, general secretary of the committee of organization, 16 quai de l'Université, Liège.

The International Engineering Congress at St. Louis.

(*Continued from page* 1381.)

ing the past year amounted to more than $12,000,000."

Mr. S. G. Homfray, of London, discussed the paper and said in effect that elevator practise in America had for the most part followed after that of England at a considerable interval of time, a statement which would probably surprise no one more than one who has been in England and ridden on their "lifts." It was shown, however, by the speaker that many of the most prominent devices now used on American elevators were actually first devised and used on the other side.

Mr. Bryan, of St. Louis, defended the electric elevator, saying that it was perfectly practical to run an elevator from the lighting circuit if only care were used not to attempt too rapid acceleration of the elevator. He said the generator would readily stand the necessary overload for the short intervals required in operating the cars, and that so far as the generator was concerned the elevator need not therefore be taken into account at all. In a few cases of special conditions he had put in accumulators, but they were generally unnecessary. In St. Louis he said the electric elevator had practically superseded all others.

For reasons alluded to above, further account of the sessions of Section E will have to be deferred to a future date.

Friday evening the St. Louis Engineers' Club gave a smoker in the Missouri Building at the Fair Grounds, which was attended by nearly all the members and much enjoyed.

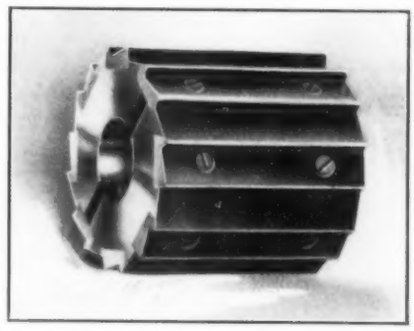
Saturday morning a general meeting was again held in the Hall of Congresses, which meeting was presided over by President Hermany and at which there were reports by the chairmen of the various sections, all of whom reported most interesting and valuable papers and discussions, and also delegates representing various foreign countries expressed in felicitous terms their appreciation of American hospitality and of the work of American engineers in and out of the congress.

The construction of a large terminal railway station at New Orleans, with every facility for loading and discharging vessels in basins constructed for that purpose, is contemplated. The situation of this dépôt will be at Chalmette, to the eastward of the city, and a few miles lower down the river.

Some New Things.

A "SOLID" ADJUSTABLE REAMER.

A particularly valuable feature of this adjustable reamer lies in the size and thickness of the blades. Each blade has two cutting edges and the extra weight and width of stock used materially reduce the liability of breakage. The blades are carefully fitted in grooves formed in the

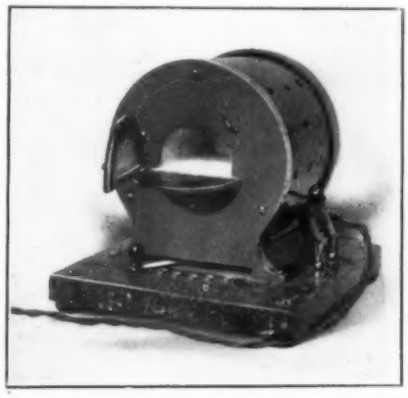


"SOLID" ADJUSTABLE REAMER.

body, and when the screws are loosened are readily set out by liners and then clamped again solidly in their seats. The body is of high carbon steel bored and slotted to fit standard arbors. The reamers are manufactured in all standard sizes, in both hand and machine forms, by the Gisholt Machine Company, Madison, Wis.

AN ELECTRIC FURNACE.

The illustration shows a small electric furnace for hardening small tools and dies, which is being introduced by Hugh E. King, 230 to 236 Adams street, Chicago, Ill. These furnaces are wound for a current of from 100 to 120 volts. A rheostat is furnished whereby the heat may be regulated. Any desired temperature within the control of the rheostat may be obtained, and maintained for any



AN ELECTRIC FURNACE.

length of time. The muffle wherein the work is placed is absolutely clean, and has a mica door, which enables the operator to watch his work. The furnaces are at present built in two sizes—No. 1, 2¾ inches wide by 1½ inches high by 3 inches long; No. 2, 4 inches wide by 2 inches high by 5 inches long. The general appearance is neat, and the machine

may be readily attached by its flexible cable to any lamp socket.

A SPECIAL STEEL PLATE FAN WHEEL.

Wall Street reports some days tell of selling movements in the market and on other days they tell of buying movements, altho for each transaction there is always both a seller and a buyer. So in the blower business the function of some of the apparatus is regarded as the delivering or forcing of air or gas at a certain place or for a certain purpose, and in others as the drawing in or abstracting of air or gas from somewhere, altho the mechanical agency is practically the same in principle and operation in either case. The latter function of the fan blower, or its use for suction or for induced draft work, sometimes imposes special and exacting conditions. For instance, when fans have to be adapted to the handling of hot gases it is necessary to keep the bearings out of the way so that they may not be overheated, and this requirement has led to the construction of the fan here illustrated. In considering the design here shown it may be well to remember that usually the fan is of considerable size. For instance, two large units have been built with the wheels 11 feet in diameter to furnish induced draft in the power-house of a street-railway plant. In the present construction the designer has avoided the objectionable features of both a thru shaft with a bearing on each side of the wheel, one of which would necessarily be in the path of the heated current, and also of an overhung wheel with a hub at one side. As shown in Fig. 1, the hub of the wheel is at or near the center laterally, and in Fig. 2 is shown how the bearing is permitted to be brought in close to the hub by the inwardly projecting conical shape of the case. It will be seen that the spider of the wheel is made of I-beams which have about three times the strength of a double set of T-arms as usually employed. In addition to this, every blade has bar-iron braces from the rim to the center, completely overcoming any tendency to twist. The cantilever bearing which extends into the conical shell is water jacketed. These fans are built by the American Blower Company, Detroit, Mich.

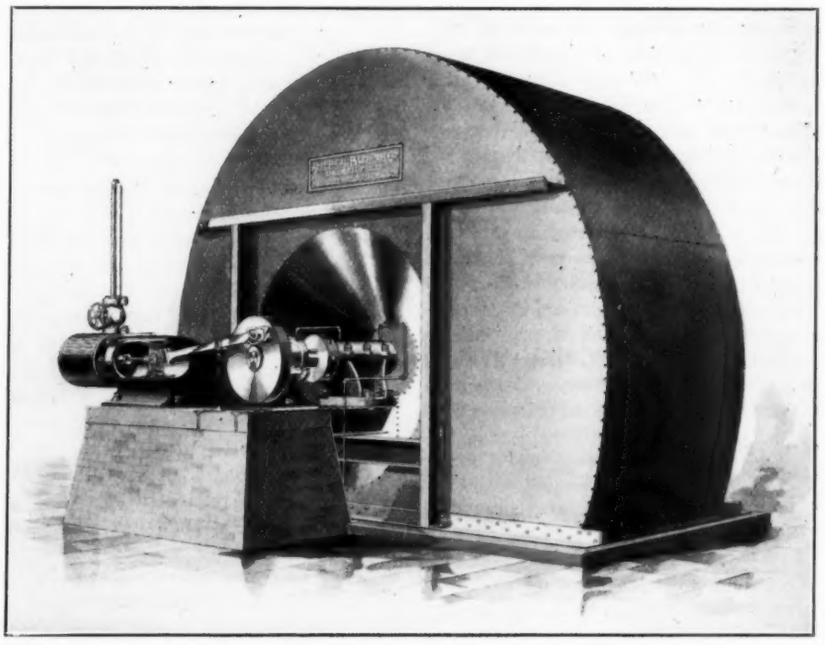


FIG. 2. SPECIAL CIRCULATING FAN FOR HOT GASES.

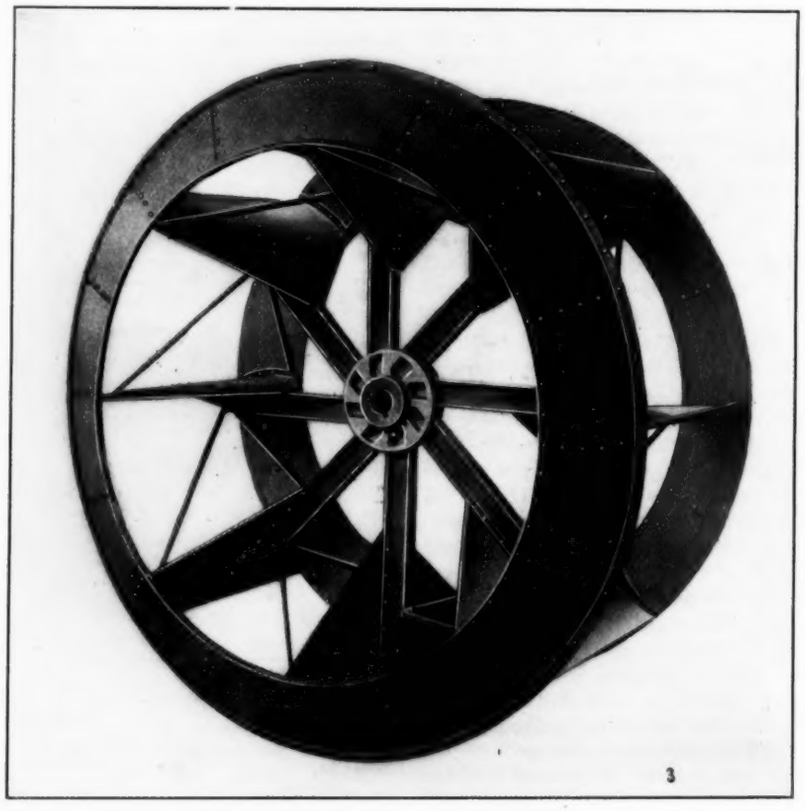
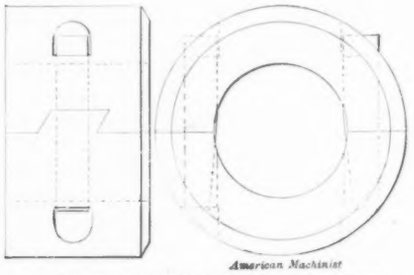


FIG. 1. SPECIAL STEEL PLATE FAN WHEEL.

IMPROVED SPLIT COLLAR FOR SHAFTING.

The collar here shown is evidently quickly and easily applied and should hold securely. The halves of the collar are united by an oblique tongue and groove, and when the pins are inserted the parts cannot be separated whether the collar is on the shaft or not. The holes for the pins are drilled straight and cut into or overlap the shaft hole an appreciable distance. The pins are normally straight and an easy driving fit in the holes, and are flatted obliquely on one side sufficiently to clear the shaft when they enter but to tighten upon the shaft and hold the collar securely in position when they are driven farther. These collars are made by David B. Snyder, Columbus, Ind.



IMPROVED SPLIT COLLAR FOR SHAFTING.

20-INCH HIGH-SPEED LATHE.

This lathe has been designed to meet the demands created by the use of the new high-speed steels, and at the same time to handle satisfactorily small parts, as well as the larger classes of work within its capacity. The bed is of a broad box pat-

tern stiffly ribbed; the spindle runs in self-oiling, phosphor bronze boxes, and has double back gears, the ratios being 3½ and 12 to 1. The drive is by a three-step cone pulley taking a 3¾-inch belt, the largest step being 14 inches and the smallest 9¼ inches diameter. The front bearing of the spindle is 3½ inches diameter by 5½ inches long, and the hole thru the spindle is 1 7-16 inches diameter. With the three-speed countershaft shown, twenty-seven speeds are obtained, eighteen of which are of course geared. The carriage has bearing surfaces at front and rear 29 inches long by 1½ inches wide, is fitted with compound rest, and power cross and angular feeds with graduated adjustments are provided. At the right of the apron is a handle for reversing the carriage feed, this handle controlling, thru a rod, reversing mechanism placed under the head. The cutaway tailstock is clamped by two bolts, the front one of which is adjustable in a slot to clear the compound-rest handle. The change gears in the equipment cut from 2 to 23 (including 11½) threads per inch and for each thread five rates of feed for turning are obtainable, these ranging from 0.0035 to 0.125 inch per turn of spindle. The gear box for the five changes will be noticed under the head in Fig. 1. Its mechanism is arranged as in Fig. 2. The lower set of gears is carried freely on a hollow shaft driven thru the change gears which actuate the short shaft at the top of the bracket, the latter shaft being coupled to or disconnected from the feed screw by a clutch. A sliding key operated by the lever to the right of the gear nest connects any one of the five gears to its shaft, thus causing it to act as a driver for the gear cone and feed rod directly above. This lathe is built by P. Blaisdell & Co., Worcester, Mass., who will equip the machine with their pulley turning attachment if desired.

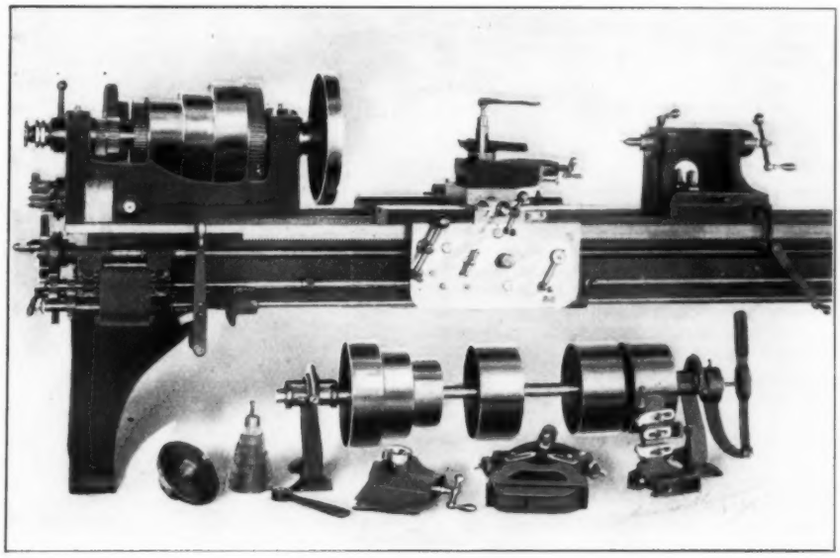
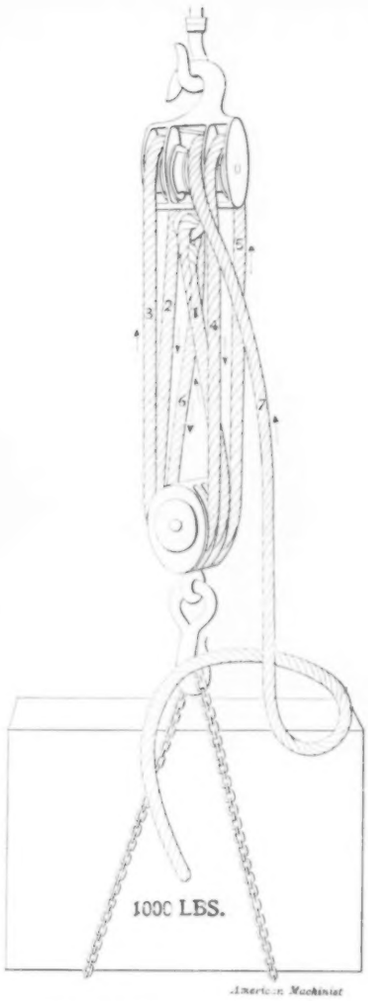


FIG. 1. 20-INCH HIGH-SPEED LATHE.



SELF-LOCKING TACKLE BLOCK.

SELF-LOCKING TACKLE BLOCK.

This block, as its name implies, is a self-locking affair and will hold the load suspended at any point in the lift when the hauling part of the rope is drawn to the right and allowed to run in between the sheave and the obliquely placed roller shown near the top of the block opening. The rope is led off to the side as shown,

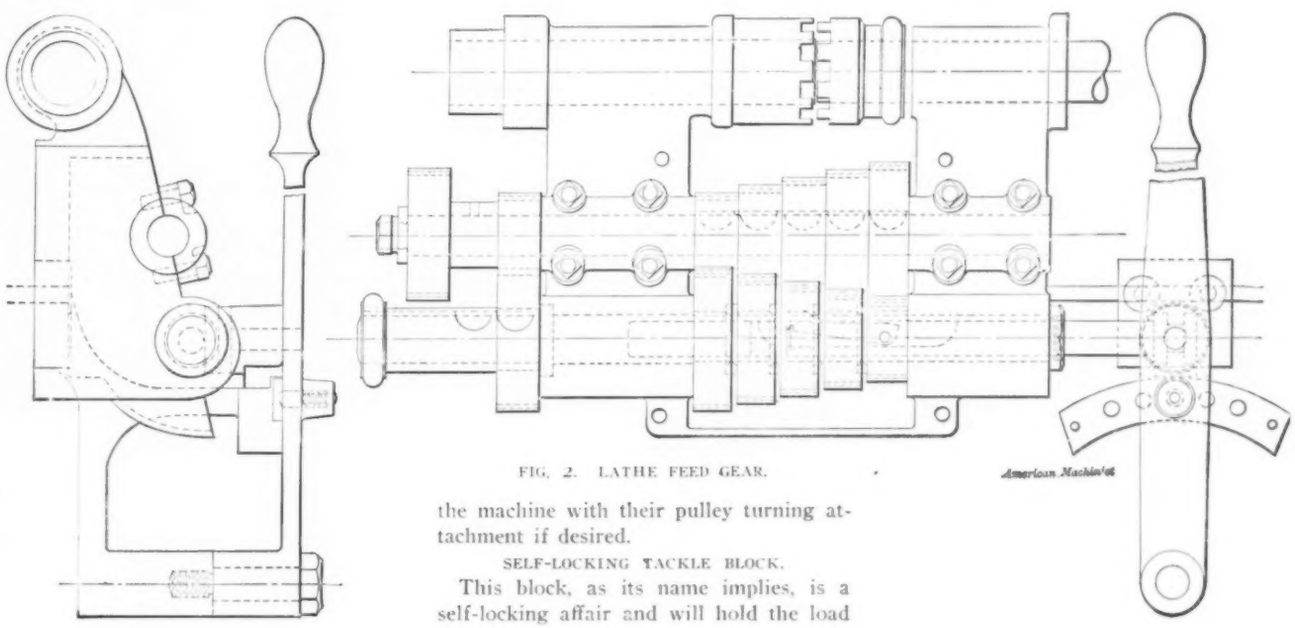


FIG. 2. LATHE FEED GEAR.

and gripped firmly between sheave and roller—when held to the right and allowed to run back slightly—by means of a shallow spiral groove or path leading off from the circumferential groove in which the rope normally travels. A short pull on the fall releases the load and a slight movement toward the left guides the rope back to its former path on the sleeve, the roller above preventing jamming of the rope, and thus allowing it to be released easily. The block is made in various sizes, and for loads up to 4,000 pounds, by the Walton Self-Locking Block Company, Boston, Mass.

A BLACKBOARD COMPOUND.

Levi Hornor, Wichita, Kansas, has recently obtained a United States patent for a composition of matter for application to the walls of buildings or other surfaces where a blackboard is wanted. The ingredients are: 1 part plaster of paris, 2 parts lampblack and 3 parts Portland cement. Whether the parts are by weight or otherwise is not stated. The ingredients are thoroughly intermixed and blended into a homogeneous compound, a sufficient quantity of water being added to give the consistency of paste. The compound is then spread upon the walls of the buildings or other surfaces to be coated with a trowel or other tool, or it may be molded in slabs of suitable length and secured to the walls in any desired manner. The crystallization or setting holds the lampblack unchanged in the mixture, forming a solid impervious cake of the same density and color throughout its mass. The compound thus applied presents a hard, black finish which will effectually resist the action of water, will not rub off and will readily take chalk-marks, which may be easily erased.

Personal.

J. K. Robinson, of Iquique, Chili, who represents the Westinghouse and other United States manufacturing interests on the west coast of South America, is now in this country, with headquarters with William E. Peck & Co., 116 Broad street, New York.

H. L. Risley, chief engineer of the Newcastle-on-Tyne Electricity Supply Company, Ltd., is now in this country. The company's plant supplies current for the Armstrong-Whitworth shipbuilding yards and other large works, as well as furnishing power for the electric line recently inaugurated by the Northeastern Railway.

Business Items.

The partnership heretofore existing between Messrs. John G. and Eugene I. Blount under the firm name of J. G. Blount & Co., manufacturing and selling metal-working machinery, etc., Everett, Mass., was dissolved on October 3. The business will be continued by the J. G. Blount Company, a corporation organized under the laws of Massachusetts.

Dodge & Day, engineers, Philadelphia, Pa., have placed the orders for generators and motors for Alexander Brothers, Philadelphia, with the Western Electric Company; for the shafting, hangers, etc., with Geo. V. Cresson Company, and for wiring with the Buchanan Company, all of Philadelphia. This firm of engineers has just been commissioned to install a heating system in the building lately acquired by Alexander Bros. at 412 North Third street, Philadelphia, and has also taken charge of the installation of additional motors at the plant of Schaum & Uhlinger, Second street and Glenwood avenue, Philadelphia.

The Northern Electrical Manufacturing Company, Madison, Wis., recently shipped to the New York Edison Company, thirty-four of its variable-speed motors operating on the Northern two-wire field control system. These motors will be directly coupled to blowers for cooling the transformers in the various substations of the company. There were also shipped recently, nine small Northern motors to be installed in the sub-stations of the Brooklyn Rapid Transit Company. This makes a total of seventy-five Northern motors now in use by the two companies, aggregating 1,500 horse-power. A 60-kilowatt Northern balancing set has been shipped to the New York Edison Company for the equipment of its Waterside station.

Manufacturers.

The Upson Nut Company thinks of enlarging its Cleveland, O., plant.

The hosiery mill of W. H. Sheafer, at Wiconisco, Pa., has been burned.

The Indiana Canning Company, Evansville, Ind., intends to enlarge its plant.

The rug factory of the Fries-Breslin Company, in Camden, N. J., has been burned.

The plant of the Greenville (Miss.) Boiler & Machine Works has been damaged by fire.

The plant of the American Sheet Iron Company, Phillipsburg, N. J., has been burned.

The planing mill of the People's Lumber Company, at or near Salem, O., has been burned.

It is stated at Lanark, Ont., that an addition will be built shortly to the Clyde Woolen Mill.

The branch factory of the Columbus (Ind.) Handle & Tool Company at Madison has been enlarged.

Alterations are about to be made to a machine shop of Schutte & Koerting Company, Philadelphia.

C. H. Snow, of Willow Point, Broome County, N. Y., is interested in a brick factory project.

The Stewart Iron Works Company, of Covington, Ky., is to have an addition to employ about 100 more men.

The Talk-O-Phone Company, Toledo, O., is about to issue bonds for the increase of facilities for manufacture.

S. H. French & Co., paint and varnish makers, Philadelphia, are starting to build a plant in Camden, N. J.

The car wheel foundry of the Bass Foundry & Machine Company, Ft. Wayne, Ind., has just been enlarged.

The Ravenna, O., plant of the Overland Worsted Mills Company will be enlarged to the extent of $100,000.

The National Ice Company, San Francisco, Cal., will, it is understood, build a 50-ton-a-day plant at Riverside.

The Board of Trade, Mt. Holly, N. J., may secure a plant from Philadelphia, Pa., for the manufacture of hosiery.

The Business Men's Association, Paterson, N. J., is in touch with two silk plants which think of locating there.

The Hendrick Manufacturing Company, perforated metals and oils, Carbondale, Pa., has broken ground for additions.

The Bettendorf Metal Wheel Company, Davenport, Ia., and Springfield, O., is erecting a new building at Springfield.

Tenders have been asked for building an addition to the plant of the Chipman-Holton Knitting Company, Hamilton, Ont.

The Reedy Elevator Company, Cincinnati, O., is to have a 76x100-foot, two-story plant erected on Second street, near Vine.

The McCaskey Register Company, Alliance, O., is building an addition and will erect another for the wood-working department.

The Colonial Distillery Company's plant at Trebeins, O., which was burned several weeks ago, may be rebuilt at some other place.

The Covington, Ga., machine shops have changed hands. E. C. Rainey, of Eatonton, the purchaser, intends to enlarge the plant.

A contract has been let to build a 232x165-foot addition to the machine shops of the Brown Cotton Gin Company, New London, Conn.

Nanton Whinary and son, of Toledo, O., have visited Saginaw, Mich., looking into the possibilities of starting a canning factory there.

The Mihalovitch-Fletcher Company, Cincinnati, O., distiller, etc., has purchased property on which it expects to erect a large plant.

A. F. Allen, of Shady Dale, Ga., is organizing a company at Cordele to manufacture his patent cotton planter and fertilizer distributor.

Work has begun for the erection of a new foundry building for the Davies & Thomas Company, Catasauqua, Pa. It will be 231 feet long.

The Conrey & Birely Table Company, Shelbyville, Ind., has let a contract for a new building, three stories, 60x150 feet, at its large plant.

The Union Machine Company, paper machinery, Fitchburg, Mass., has bought 100 acres at Westminster and is expected to build a plant there.

A nut and bolt works, an automobile factory and an automatic screw machine or screw-making concern are looking for locations in Peoria, Ill.

The Ontario-Slocan Lumber Company, Orillia, Ont., and Slocan, B. C., proposes to proceed with the completion of its sawmill plant at Slocan before long.

Colgate & Co., manufacturers of soap, etc., Jersey City, N. J., are about to erect another factory building, 78½ feet wide, 83½ feet deep and 75 feet high.

The City Improvement Association, Three Rivers, Mich., is in communication with Mr. Bickhart, of Leslie, who thinks of building a new flour or grist mill.

Henry Behrens & Co., of Winona, Minn., are erecting a factory for the manufacture of washboilers and antirust ware, besides spoons and other small articles.

Preparations have been made for the fiftieth anniversary of the Walker & Pratt Manufacturing Company, stoves and heating apparatus, Watertown, Mass.

The Iron Rolling Mill Company, of Fort Worth, Tex., has let the contract for the bolt building, 60x200 feet. Contracts for other buildings are to be let later.

By order of the United States court the plants of the American Clay Working Machinery Company in Willoughby and Bucyrus, O., are to be sold October 20.

A 227x102-foot, two-story office building and repair shop is about to be built at Second and Wyoming streets for the Philadelphia Rapid Transit Company.

By a fire which burned a plant at Chehalis, Wash., of the International Milk Condensing Company, valuable machinery was destroyed, especially in the can-making department.

A permit has been granted the Pittsburg (Pa.) Valve Foundry Company for a brick and steel shop and office at Twenty-sixth street and the Allegheny Valley railroad.

The Duluth (Minn.) Tar Compahy has bought 50 acres and proposes to build a plant for the utilization of the tar product of the Zenith Furnace Company, it is understood.

Edward R. Ladew has succeeded Fayerweather & Ladew, leather belting, New York city (factory Glen Cove, L. I.); also the Fayerweather & Ladew Company, Charlotte, N. C.

It is stated at Uniontown, Pa., that work is about being started by the McConnell Wheel & Mine Supply Company on a building to be used for a wood-working and machine shop.

The Friedman-Blau-Farber Company, Cleveland, O., has been organized to manufacture knit goods. The temporary headquarters are at 21 Bank street. A large factory is proposed.

The Moosehead Woolen Company, of which F. H. Drummond, of Bangor, Me., is treasurer, and whose plant at Abbott was burned some time ago, is expected to rebuild next spring.

It is stated at Eugene, Ore., that W. J. Wilsey, manager for the Willamette Valley Electric Railroad Company, announces that surveyors are surveying sites for power plants.

The American Oak Leather Company, Cincinnati, O., or allied interests, will, it is understood, locate a tannic acid factory at Harriman, Tenn., to cost in the neighborhood of $100,000.

A four-acre factory site at Grand Rapids, Mich., has been purchased by E. W. Stiles, who, with his son, will continue the business of Stiles Bros. there. Sash, doors and blinds will be made.

A new enterprise in Knoxville, Tenn., which is making machines for bagging purposes, is the Whittle Bagging Machine Company. The machines are used especially for packing meats.

A representative of the Cleveland (O.) Reversible Window Company has visited the Commercial Club, Council Bluffs, Ia., to confer on a proposition for the opening of a branch factory.

The contract has been let for the erection of a six-story addition, 52x175 feet, and a one-story building at Jamaica Plain, Boston, Mass., for the Thomas G. Plant Company, shoe manufacturer.

The contract has been awarded for a two-story and basement addition, 40.6x64.3 feet, to the plant of the American Fork & Hoe Company, at Ashland avenue and Frankford Creek, Philadelphia.

The Fred M. Prescott Steam Pump Company, Milwaukee (or West Allis), Wis., is making additions to its plant. Work has been begun on the foundations of the machine shop extension.

The Western Iron Works Company, of St. Paul, Minn., has been incorporated with a capital of $10,000. Edwin J. Curry, J. B. Mathieson, T. D. Patten and George Bealz are the incorporators.

The automatic Settler Company, El Paso, Tex., is a new concern which proposes to establish a plant to make a mining device patented by Charles Allen, who has an office there on El Paso street.

The Twentieth Century Cash Register Company will build a factory at Barberton, O. The company is controlled largely by officials of the Carrara Paint Company, which also has a plant in Barberton.

A company has been organized at Fort Worth, Tex., to build a bolt and nut factory at a cost of $200,000. W. K. Fogg, of Ohio, is president. Employment will be given to between 300 and 400 people.

The Reed Manufacturing Company, Springfield, O., has built a shop, 30x95 feet, 2½ stories. It will manufacture rag carpet and rug looms, also bread mixers, bread kneaders and cement building blocks.

The Fair Haven Art Glass Company has been formed, and it will build a plant, 112x150 feet, two stories, at New Haven, Conn. The president is Chas. G. Denman; secretary and treasurer, Wm. H. Rowan.

A large fire in New York has damaged packing-house and refrigerating establishments, including plants occupied by the Cudahy Packing Company, T. H. Wheeler Company and G. H. Hammond Company.

J. Clove, of the Rigby-Clove Manufacturing Company, maker of combined harvesters, Pendleton, Ore., is quoted as saying that sufficient stock has been subscribed to insure the location of a new factory in Portland.

Plans have been made for a plant for the Red Jacket Manufacturing Company, Davenport, Ia., with a foundry, 85x200 feet; machine shop, 82x200; rattling room, 40x80; power house, 32x50; pattern vault, 40x60.

The Commercial Club, Sioux City, Ia., has secured for that place the Iowa Foundry Company, which will begin operations at a recently acquired plant on West Third street. H. C. Christiansen & Sons are the proprietors.

The Ingram Lumber Company has been organized, the incorporators being C. S. Curtis, A. H. Clark, F. H. Pardoe and Peter Dahl, all Wausau, Wis., men. The company proposes to build a mill at Ingram, Gates County, Wis.

A plant will probably be built at Marion, Ind., by the Morris Hardware Company, recently incorporated. John Morris, of Marion, of the Morris Hotel, is interested. The matter will be brought before the Commercial Club.

Dr. J. S. Henderson, of Oskaloosa, Ia., has closed a deal for the manufacture of artificial ice at Waterloo. The company will erect a plant this fall with a capital of $50,000. It will be known as the Waterloo Artificial Ice Company.

The rapid-fire gun works of the Driggs-Seabury Ordnance Company, at Sharon, Pa., will, it is reported, be enlarged a second time before the foundations are completed and the main building be made 440 feet in length instead of 300.

Edwin Gledhill, business manager of the Marston Worsted Mills, Skowhegan, Me., is at the head of a spinning factory to be established there. The new concern is called the Maine Spinning Company. A building has been secured.

The National Drill Company, Cambridge City, Ind., has been purchased by the Roderick Lean Manufacturing Company, Mansfield, O. It is the purpose to double the capacity. The factory will make a specialty of drills and cultivators.

B. F. Freeland, who has been manufacturing steel tanks at Middlebury, Ind., has purchased the plant of the Star Tank Company, Goshen, Ind., and will manufacture on a larger scale. The Star company has bought another building.

Nashville, Tenn., thinks it has substantially assured the location there of a Southern plant of the American Skein & Foundry Company, of Chicago, Ill., and elsewhere. The Retail Merchants' Association has been working on the matter.

The Clover Leaf contracted to carry, about October 8, the 400 employees of the American Arithmometer Company from St. Louis, Mo., to Detroit, Mich., together with the household goods of the employees. The company has just completed a new factory in Detroit.

Lithographic stone quarries near Highrolls, Otero County, N. M., are proposed to be developed by Cleveland, O., parties, including H. W. Fleming; J. M. Blodgett, a banker and broker; J. M. Bour, importer of teas, etc., and Jas. E. Smith, a practical lithographer.

The damage by fire to a plant of the J. A. Fay & Egan Company, Cincinnati, O., will, it seems, be less than earlier reported, and it is fully covered by insurance. The amount is a comparatively small proportion of the value of the company's property. Repairs are to be made at once.

The B. Henley Swivel Coupling Company has been incorporated with a capital stock of $10,000 by Brown Henley, Emil J. Anderson *et al.* The headquarters are at Youngstown, O. It is erecting a plant at Edenburg, where Mr. Henley resides. He is the inventor of a swivel coupling for carriages.

A new starch company, the Maize Product Company, has filed incorporation papers in Albany and is expected to build a plant in Oswego, N. Y. The capital stock will be $200,000. A. P. Murdock and Karl Kellogg, of Oswego, and William P. Beardsley, of Auburn, are named as directors.

The Wabash Valley Foundry & Machine Shops, of Vincennes, Ind., operated by Frank Clark and H. A. Buck since 1875, have been purchased by E. S. Sheperd, secretary-treasurer of the Vincennes Paper Company, who will put in new equipment throughout, including the latest machine tools.

Dr. A. McKechnie, of Pittsburg, Pa.; Dr. Taft, of Vick Park, Rochester, N. Y., *et al.*, are arranging for the establishment of a plant near Mumford, N. Y., to make plaster from wood pulp, etc. The Consolidated Wheatland Plaster Company, of Mumford, is in touch with the new enterprise.

The Mayo Life Boat Company wants the council of Monroe, Mich., to furnish ten acres of land on the water front with railroad facilities. For this it agrees to erect a plant costing $50,000, and will employ 150 men. The officers of the company are making Sandusky their headquarters.

Yearwood & McDonald, a firm of naval stores operators, of which John B. McDonald, Melrose, Fla., is a member, propose to erect a plant on the shore of Lake Santa Fe, near Melrose, with a capacity of 30,000 feet of lumber, 100,000 shingles and several thousand vegetable and fruit crates daily.

The National Brass & Metal Company, Minneapolis, Minn., will begin November 1 the construction of a three-story manufacturing building, 66x120 feet. It is expected to have the structure ready for occupancy by March 1. The concern is also negotiating for the erection of a new factory at Winnipeg, Man., as a branch.

The Burrell Manufacturing Company, machinist, of Bradley, Ill., has taken out the papers for the increase of its capital stock from $10,000 to $25,000. Most of the new stock will probably be placed with Chicago parties, who are engaged in the same line of business and expect to move to Bradley and consolidate with the company.

Three Seattle, Wash., men, Leonard P. Spear, A. L. Sutton and H. M. Orr, have secured the exclusive right to manufacture and sell in the State of Washington coaline, a new kind of fuel. It is a patented article, made of coal dust and coal washings compressed. They have incorporated and intend to construct a plant at Issaquah.

A factory will be established at Fort Dodge, Ia., for the manufacture of the four-horse evener of J. F. Ford and others. The enterprise will be known as the Ford Manufacturing Company. Some of the machinery for the manufacturing of the iron work has been ordered. The factory will be later enlarged and other farm implements built.

The Muskogee Oil Refining Company has filed articles of incorporation at Muskogee, I. T., in the office of the United States clerk. The incorporators are Alfred Abeel, C. T. Madison and John R. Finks, of Corsicana, Tex., and H. G. Baber and Grant Foreman, of Muskogee. The company is capitalized for $50,000 and will, it is reported, build a plant.

The Phoenix Fire Extinguisher Company, Chicago, Ill., has closed a contract with the Chicago Heights Land Association for the location of its works in Chicago Heights. The officers of the company are Martin Andrews, president; Rockwell King, vice president; R. J. Ryerson, secretary and treasurer. The general office of the company will be in Chicago Heights.

The directors of the Adder Machine Company, of Detroit, Mich., have decided to locate the factory at or near Wilkesbarre, Pa. A factory to accommodate 500 employees will be built. Electric power will be used. The product of this company comprises five different adding machines, among which is one that can be used in connection with any of the standard typewriters.

A plant at Akron, O., is proposed by the Williams Electrical Machine Company, which has just been formed. The incorporators are Harry Williams, J. F. Townsend, W. S. Matthias, Talma R. Smith and J. V. Welsh; capital stock, $100,000. The company will manufacture electrical machinery and supplies of many kinds. Mr. Williams is the inventor of an electric safety clutch.

The American Agricultural Packing Company, organized in New York with a capital stock of $2,500,000, will be the next addition to the stock yards industries of Chicago. Thomas W. Tallafera will be the manager and F. A. Wilder the superintendent of the new plant. Both have been for years connected with the packing industry of Chicago. The plant will consist of six buildings.

The Geiser Manufacturing Company, manufacturer of threshers, engines, sawmills, etc., Waynesboro, Pa., will increase its capital stock from $750,000 to $1,000,000 in December. Employees from Waynesboro have started to work in the company's plant at Greencastle, erecting machinery to be used in manufacturing the Metcalfe gasoline engine. The new foundry, 60x216 feet, will soon start up.

The Chandler & Taylor Company, manufacturer of engines, etc., Indianapolis, Ind., has let the contract for its boiler shop on its new site. The building will occupy a space 114x200 feet, and when the machinery is installed it will represent an outlay of between $30,000 and $35,000. The company's foundry at the new site has been finished for some time. One feature at the new plant will be the assembly hall, which will be 80x100 feet. Reading-rooms and other conveniences for the employees will be prepared. In all, nine buildings will be erected.

The Union Iron Works, San Francisco, Cal., one of the properties of the former United States Shipbuilding Corporation, has been sold at public auction by order of the Federal Court of the District of New Jersey. The only bidder was Francis D. Pollock, representing the reorganization committee of the new shipbuilding company, 70 per cent. of the stock of which is said to be owned by Charles M. Schwab. His bid, the minimum allowable under the terms of sale, of $1,700,000, was accepted. When the reorganization is complete the new company will be capitalized at $33,000,000, of which $3,000,000 will be in bonds. Mr. Schwab is quoted as having expressed an intention to make the Union Iron Works the greatest of the sort in the country, if not in the world.

New Catalogs.

Norton Emery Wheel Company, Worcester, Mass. Leaflet descriptive of "India" oil stones.

The Hart & Cooley Company, New Britain, Conn. Miniature catalog of steel lockers. Illustrated. 3¼x6, paper.

Gisholt Machine Company, Madison, Wis. Illustrated price list of solid adjustable reamers and arbors made by this company. 4x9¼, pp. 15, paper.

Kempsmith Manufacturing Company, Milwaukee, Wis. "Kempsmith" milling machines and attachments, described in detail and illustrated. 3¾x6, pp. 12, paper.

Northern Electrical Manufacturing Company, Madison, Wis. Bulletin No. 37, illustrating a number of representative applications of Northern variable-speed motors to machine tool drive. 7x10, pp. 11, paper.

American Balance Valve Company, San Francisco, Cal., and Jersey Shore, Pa. "Jack Wilson" balanced high-pressure slide valves, described in detail and illustrated by half-tones and drawings. 6x9, pp. 35, paper.

New Jersey Foundry & Machine Company, 9-15 Murray street, New York. Booklet describing the "Omega" toggle for fastening brackets and fixtures to hollow brick, tile, wood and metal lathing, etc. 3½x6, pp. 12, paper.

J. E. Reinecker, Chemnitz-Gablenz, Germany. Illustrated catalog of milling machines, plain, universal, hand, vertical and special, gear, worm and worm wheel cutting machines, horizontal and vertical boring machines, cutter grinders, grinding machines and lathes. The catalog is excellently printed and contains interesting interior views of the Reinecker works. Many of the machines are of novel and interesting design. 5x7½ inches, pp. 287, cardboard.

R. K. Le Blond Machine Tool Company, Cincinnati, Ohio. Catalog showing the full line of lathes made by this company, including standard engine lathes from 10- to 30-inch swing, quick-change lathes, high-speed engine lathes, reducing lathes, motor-driven lathes, manufacturer's lathe, gap lathes and turret lathes. The machines are described fully and illustrated in detail. There are a number of interesting features shown, such as translating gears, the use of which enables both United States standard and metric pitches to be cut with Le Blond lathes; the coarse threading attachment which can be used on all Le Blond lathes, and the gear arrangement in the quick-change lathes. 6x9, pp. 91, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Addressing machines for office use. Joline & Co., 123 Liberty St., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light mach'y to order; model work; rubber molds. J. W. Weir, Bridgeport, Conn.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

A practical book, "Dies and Diemaking," post paid $1. J. L. Lucas, Bridgeport, Conn.

Steel name and monogram name stamps; diesinking; write for estimates. J. L. Lucas, Bridgeport, Conn.

Automatic machinery designed and constructed by the Wellman Sole Cuting Machine Co., Medford, Mass.

Wanted—Scranton School books, mechanical engineering course. Particulars to Box 456, AMERICAN MACHINIST.

Auto. machinery of all kinds designed and built; hardened and ground work, flat or circular. Wiebking, Hardinge & Co., Chicago.

Have several thousand dollars to invest, with services, in good, profitable business; manufacturing preferred. Box 462, AM. M.

For Sale.

Twelve "Hartford" automatic stud machines, complete with wire stands and countershafts; will be sold cheap to close bankrupt estate. Frank H. Allen, Norwich, Conn.

For Sale—1 Farrel Foundry hydraulic pump and press; 800 tons; cost $1,950; will sell very reasonable; perfect condition. H. M. Crowell Mfg. Co., 6th ave. and 13th st., Newark, N. J.

Patterns, drawings, jigs and special tools, with many nearly finished parts for a modern, heavy, 16 in. and 18 in. engine lathe; fine chance to build yourself 3 or 4 lathes, and clear cost of outfit. Box 478, AM. M.

I can sell your machine shop (or other business), with or without real estate, no matter where it is or what it is worth. Send description, state price, and learn how. W. M. Ostrander, 111 North American Bldg., Philadelphia.

Fire Sale—Bargain Prices.—Bench lathes; forges, $6.90; Yankee calipers; dividers, inside, outside, 3, 4, 5 in., 35c.; steel scales, 4 to 9 in., 25c.; 13 Jennings bits in canvas roll, ¼ to 1 in., regular price $3, our price $2.15; Besly disc grinder; screw cutting lathe, $40; three-dollar breast drills, $2; Swiss and Stubs files, 4 to 8 in., retail 50c. to 75c., our price 20c.; combination squares, 12 in., complete, hardened blade, $1.10; combined drill gauge and block, hold 60 drills, retail $5, our price $3.75. Call before assortment is broken. Frasse Co., 38 Cortlandt st., New York.

For Sale—Four Watts-Campbell Corliss engines, 24x56; 400 horse-power at 100 lbs. steam pressure; 70 revolutions per minute; flywheel—diameter 20 ft., face 46 in.; condition first class. One double Watts-Campbell Corliss engine, 18x42; 250 horse-power at same pressure; 91 revolutions per minute; flywheel—diameter 16 ft., face 32 in. One N. Y. Safety engine, 12x12; 75 horse-power at same pressure; 250 revolutions per minute; 2 belt wheels, 4½ ft.; diameter 17½ in. and 13 in. face. Will sell singly. Can be seen in New York city by addressing The United Electric Light & Power Company, 1170 Broadway New York city.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Machine shop foreman; wide experience; automatic machinery and machine tools; age 34. Box 420, AMERICAN MACHINIST.

A manager and superintendent of a well-known Connecticut concern would like to correspond with parties in want of a general manager or superintendent with plenty of business tact, mechanical and executive ability, practical and up to date; can handle the mechanical and business end if required; look me up and get my reasons for wishing to make a change; have had the experience you require; if you are starting new, I am the man you want; right in my prime and a hustler. "Inventive," care AMER. MACH.

ENGLAND.

A firm of engineers can thoroughly recommend their works manager, who has been with them for the past four years and who is a good engineer and commercial man, with 20

Radial [Stresses Due to Centrifugal Force in Revolving Bodies.

BY A. M. LEVIN.

In connection with the design of steam turbines, details which are expected to revolve at high velocities are frequently met with, and the question arises: to what extent will the material be strained, due to the centrifugal force when revolving at the required speed, and what form, if given to the revolving body, would insure the greatest strength? The determination of the strength of a detail in general machine construction is often made indefinite, on account of the uncertainty of the exact magnitude of the forces which may act upon it. In regard to the centrifugal forces, however, they are very definite and may be determined with a great deal of exactitude for the simple forms generally used, so that, if the strength of the material is definitely known, the highest velocity to which it may be safely speeded can be determined closely.

Fig. 1 represents a circular ring of homogeneous material and of even thickness. The centers of gravity of the two half-circular plates, of diameters D and d, are located at points c and c_1, respectively, and the distances from these points to the diameter are as marked in the figure. The location of the point c_2, which is the center of gravity of the half-circular ring, is not generally given in any mechanic's handbook, but it can be easily determined, as the moment of the force, due to gravity acting in c, relatively to the diameter, must be equal to the sum of the moments of the forces acting in c_1 and c_2, relatively to the same axis, thus:

$$\frac{1}{2}\frac{\pi D^2}{4}\times\frac{2}{3}\frac{D}{\pi}=\frac{1}{2}\frac{\pi}{4}(D^2-d^2)\rho+\frac{1}{2}\frac{\pi d^2}{4}\times\frac{2}{3}\frac{d}{\pi}$$

which gives $\rho=\frac{2}{3\pi}\frac{D^3-d^3}{D^2-d^2}$ expressed in inches, if, as we assume, the diameters D and d are given in inches, or $\rho=\frac{1}{18\pi}\frac{D^3-d^3}{D^2-d^2}$ expressed in feet.

The centrifugal force acting in c_2, perperpendicular to $a-b$, is

$$C=\frac{W}{g}w^2\rho,$$

W, being the weight of the half-ring $=\frac{1}{2}\frac{\pi}{4}(D^2-d^2)\,t\,\gamma$,

g = the acceleration due to gravity,

w = angular velocity of the ring,

ρ = the distance from the center of gravity of the half-circular ring to line $a-b$.

Besides these symbols the following will be used:

V = the periferal speed of the ring in feet per second,

t = the thickness of the ring in inches,

γ = the weight of the material per cubic inch in pounds.

Inserting the values for W and ρ in the formula above, we get:

$$C=\frac{1}{2}\frac{\pi}{4}(D^2-d^2)\,t\frac{\gamma}{g}w^2\,\frac{1}{18\pi}\,\frac{D^3-d^3}{D^2-d^2}$$

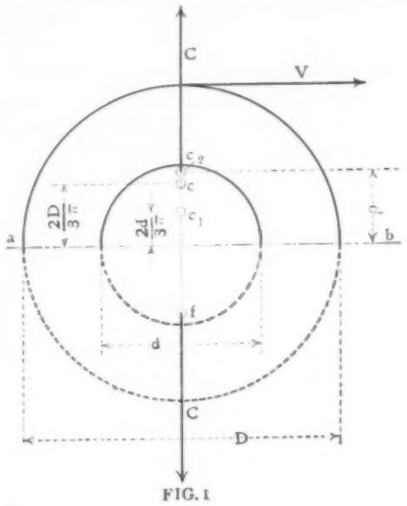


FIG. 1

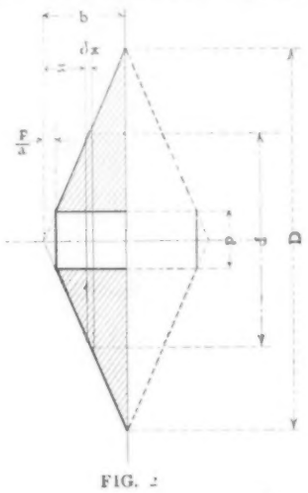


FIG. 2

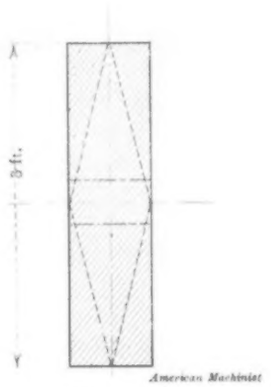


FIG. 7

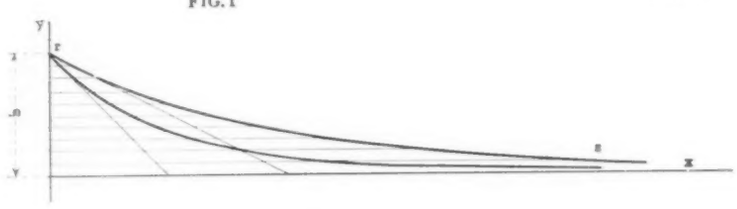


FIG. 3

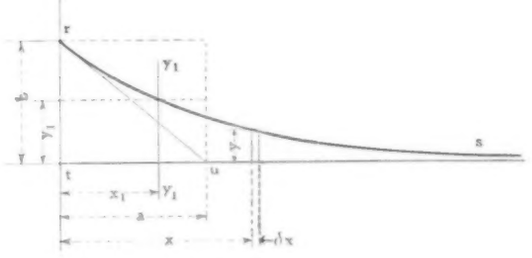


FIG. 4

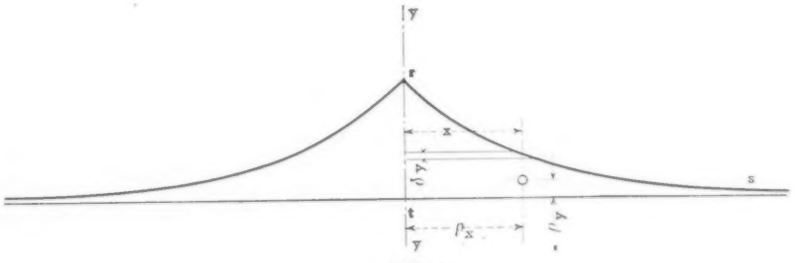


FIG. 5

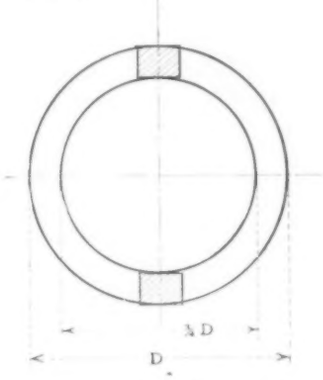


FIG. 6

RADIAL STRESSES DUE TO CENTRIFUGAL FORCE.

or

$$C = \frac{1}{144}\, t\, \frac{\gamma}{g}\, w^2\, (D^3 - d^3) \qquad (1)$$

The angular velocity expressed in periferal velocity is $w = \frac{2 \times V \times 12}{D}$ and $w^2 = \frac{4 \times V^2 \times 144}{D^2}$, which substituted in equation (1) gives:

$$C = 4\, \frac{\gamma}{g}\, t\, \frac{D^3 - d^3}{D^2}\, V^2 \qquad (2)$$

The centrifugal force acting at c_2 is, of course, opposed by a similar force acting at f in the opposite direction, and between them they create a stress in the section $a - b$.

Dividing C, therefore, by the area of section $a - b = A = (D - d)\, t$, we get the stress per square inch of section.

$$S = \frac{C}{A} = 4\, \frac{\gamma}{g}\, t\, \frac{D^3 - d^3}{D^2}\, V^2\, \frac{1}{(D-d)\, t}.$$

or

$$S = 4\, \frac{\gamma}{g}\, \frac{D^2 + D\,d + d^2}{D^2}\, V^2 \qquad (3)$$

In case that the revolving body is a solid disk, instead of a ring, as assumed, then d becomes $= O$ and equations (1) and (2) become, respectively,

$$C = \frac{1}{144}\, t\, \frac{\gamma}{g}\, w^2\, D^3 \qquad (4)$$

$$C = 4\, t\, \frac{\gamma}{g}\, D\, V^2 \qquad (5)$$

and equation (3) for the strain per square inch of normal section of the disk becomes

$$S = 4\, \frac{\gamma}{g}\, V^2 \qquad (6)$$

On the other hand, giving to d a value approaching D, equation (3) will approach the value

$$S = 12\, \frac{\gamma}{g}\, V^2 \qquad (7)$$

It is evident, therefore, that equation (3) can be written in a general way

$$S = R\, \frac{\gamma}{g}\, V^2 \qquad (8)$$

where R is a coefficient, ranging between 4 and 12, which varies with the ratio between the small and the large diameter of the ring. The values of R are given later in the table.

Substituting the number of revolutions per minute and the outside diameter of the ring in feet for V in equations (6), (7) and (8) we get:

For a solid disk, $S_1 = 0.000343\, \gamma\, n^2 D_f^2$

For a ring, $S_1 = R_1\, \gamma\, n^2 D_f^2 \qquad (9)$

For a thin band-ring, $S_1 = 0.001029\, \gamma\, n^2 D_f^2$

The next step is to find the stress, due to the centrifugal force, in a revolving body the cross-section of which is tapering from the center to the perifery, as shown in Fig. 2. The plan view of it is circular and we may assume, for the sake of generalness, that there is a cylindrical hole in the center, of a diameter p.

For the sake of convenience, only the shaded half of the figure will be involved in the following computation, as the results sought will be unaffected by doing so. The centrifugal force, as given by the equations incidentally brought out, will, however, have to be doubled in order to apply to the entire figure.

The centrifugal force, acting normal to the diameter on an element of the thickness δx and of a diameter d and causing a stress in the area $d \times \delta x$, is, as shown by equation (1),

$$\delta C = \frac{1}{144}\, \frac{\gamma}{g}\, w^2\, (d^3 - p^3)\, \delta x.$$

Let the ratio between the outside diameter D, Fig. 2, and the width at center b be called a, then

$$d = a\, x \text{ and}$$

$$d\, C = \frac{1}{144}\, \frac{\gamma}{g}\, w^2\, (a^3 x^3 - p^3)\, d\, x.$$

Summing up the elements between $x = \frac{p}{a}$ and $x = \frac{D}{a}$, we get

$$C = \frac{1}{144}\, \frac{\gamma}{g}\, w^2 \int_{\frac{p}{a}}^{\frac{D}{a}} (a^3 x^3 - p^3)\, d\, x,$$

or

$$C = \frac{1}{36}\, \frac{\gamma}{g}\, w^2 \times \frac{1}{a}\, (D^4 + 3\, p^4 - 4\, D\, p^3),$$

and expressed in periferal velocity

$$C = \frac{\gamma}{g}\, V^2\, \frac{1}{D^2}\, \frac{1}{a}\, (D^4 + 3\, p^4 - 4\, D\, p^3) \qquad (10)$$

The area of the cross-section thru the center of the figure is:

$$A = \frac{1}{2}\, D\, \frac{D}{a} - p \times \frac{D}{a} + \frac{1}{2}\, d \times \frac{d}{a}$$

$$= \frac{1}{2}\, \frac{1}{a}\, (D - p)^2$$

The stress per square inch of section, due to the centrifugal force, is therefore

$$S = \frac{C}{A} = 2\, \frac{\gamma}{g} \times V^2\, \frac{1}{D^2}\, \frac{D^4 + 3\, p^4 - 4\, D\, p^3}{(D-p)^2} \qquad (11)$$

If there is no hole in the center, in which case $p = o$, then equation (10) becomes

$$C = \frac{\gamma}{g}\, \frac{D^2}{a}\, V^2 \qquad (12)$$

and the equation (11) becomes

$$S = 2\, \frac{\gamma}{g}\, V^2 \qquad (13)$$

which, expressed in numbers of revolutions per minute and in the outside diameter in feet, gives

$$S = 0.000171\, \gamma\, n^2\, D^2.$$

Comparing equations (6) and (13) we find that the stress per square inch of section is one-half as great for a solid tapering section as for one of even thickness. Equation (13) shows that the strain per square inch of section is independent of the amount of taper for a given diameter. This looks at first somewhat anomalous, but it becomes evident if we consider that, the diameter being fixed, the area of the section increases in the same rate as the taper is increased.

Equation (13) can be written in the same way as was done for rings of even thickness:

$$S = T\, \frac{\gamma}{g}\, V^2 \qquad (14)$$

Or, substituting the number of revolutions per minute and the outside diameter of the ring in feet for V, the equation becomes

$$S_1 = T_1\, \gamma\, n^2\, D_f^2 \qquad (15)$$

The coefficients T and T_1, ranging from 2 to 12, depend on the ratio between the small and large diameter of the ring.

Another form of disk, still more advantageous than the double cone as regards the strength to resist the centrifugal forces at high rotative speed, is the one generated by a logarithmic curve rotated around the abscissa axis, which is shown in section in Fig. 3. In this form the increase of section, from the perifery toward the center, can be made proportionate to the stresses due to the centrifugal force by selecting a proper generating curve.

The equation for the logarithmic curve is generally written

$$y = b \log. \frac{x}{a},$$

the logarithm being the hyperbolic logarithm. This equation gives a curve located on the negative side of the x axis for the values of x which will be considered here, it is, therefore, more convenient for the following deductions to draw the curve extending toward the positive x axis, as in Fig. 3, and to change the equation to suit the location of the curve, thus:

$$-x = a \log. \frac{y}{b} \qquad (16)$$

The curve can be easily constructed from this equation by assuming for b a certain value, for instance 10, finding the hyperbolic logarithms for the whole numbers from 1 to 10, subtracting these, successively, from the log. 10 and multiplying the results by a, as required by the equation written in the form $x = a\, (\log. 10 - \log. y)$. These final results, stepped off at corresponding divisions of b, locate ten points of the curve $r\, s$.

By selecting different ratios between a and b curves of different curvature will be obtained. Those selected in Fig. 3 are for $a = b$ and for $a = 2\, b$.

Equation (16) shows that $x = o$ when $y = b$ and $x = \infty$ when $y = o$; that is, the x axis is an asumptote to the curve.

Equation (16) may be written:

$$y = b\, e^{-\frac{x}{a}}$$

from which expression we get $\frac{d\, x}{d\, y} = \frac{a}{b}\, e^{\frac{x}{a}}$

and, as $x = o$ at the point r, Fig. 4, the coefficient for the tangent is, at this point of the curve, $= \frac{d\, x}{d\, y} = \frac{a}{b}$; that is, the tangent cuts the x axis at the distance a from origo.

Summing up the elements $y \times \delta\, x$, Fig. 4, from $x = \infty$ to $x = x_1$, we get the area included between the curve, the x axis and the ordinate $y_1 - y_1$, thus:

$$A_x = \int_{x_1}^{\infty} y\, d\, x = b \int_{x_1}^{\infty} e^{-\frac{x}{a}}\, d\, x$$

$$= a \sum_{x=\infty}^{x=x_1} b e^{-\frac{x}{a}} - b e^{-\frac{x}{a}}$$

or $$A_x = a \times y_1 \qquad (17)$$

a being the sub-tangent for the curve at the point $x = o$, equation (17) expresses that the area below the curve from $x = \infty$ to any ordinate is equal to the area of a rectangle with the ordinate and the sub-tangent for sides. This holds good also for the entire area $r\,s\,t = A$, wherefore

$$A = a \times b.$$

The centrifugal force, acting on one-half of the volume generated by the curve $r\,s$, Fig. 5, when rotated around the axis $y - y$, can be found by summing up all half-circular elements of a radius x and of a thickness $\delta\,y$ between the limits o and b. The force acting upon one such element is according to equation (4):

$$\delta C = \frac{1}{144} \frac{\gamma}{g} w^2 (2x)^3 \delta y,$$

wherefore

$$C = \frac{1}{144} \frac{\gamma}{g} w^2 8 b \int_o^\infty x^3 d e^{-\frac{x}{a}}$$

The integral of this equation is solved by adding and subtracting pairs of terms resulting in a sum of differentials thus:

$$\int_o^\infty x^3 d e^{-\frac{x}{a}}$$

$$= a^3 \int_o^\infty \left\{ \begin{array}{l} x^3 d e^{-\frac{x}{a}} \frac{1}{a^3} + e^{-\frac{x}{a}} d x^3 \frac{1}{a^3} + x^2 d e^{-\frac{x}{a}} \frac{3}{a^2} \\ \quad + e^{-\frac{x}{a}} d x^2 \frac{3}{a^2} + x d e^{-\frac{x}{a}} \frac{2 \times 3}{a} \\ \quad + e^{-\frac{x}{a}} d x \frac{2 \times 3}{a} + d e^{-\frac{x}{a}} \times 2 \times 3 \end{array} \right.$$

$$= a^3 \int_o^\infty e^{-\frac{x}{a}} \left(\frac{x^3}{a^3} + \frac{3 x^2}{a^2} + \frac{6 x}{a} + 6 \right).$$

$e^{-\frac{x}{a}} = o$ when $x = \infty$, and $x^3 = x^2 = o$ and $e^{-\frac{x}{a}} = 1$ when $x = o$; therefore

$$\int_o^\infty x^3 d e^{-\frac{x}{a}} = 6 a^3 \qquad \text{and}$$

$$C = \frac{1}{3} \frac{\gamma}{g} w^2 b a^3 \qquad (18)$$

The volume of a body generated by the area $r\,s\,t$, Fig. 5, when rotated around the axis $y - y$, will be found, by identically the same method as used for finding the centrifugal force, to be

$$\text{Vol.} = 2 \pi b a^2$$

and as $$C = \frac{\text{vol.}}{2} \times \frac{\gamma}{g} w^2 \times \frac{\rho_x}{12}, \quad \text{or}$$

$$\frac{1}{3} \frac{\gamma}{g} w^2 b a^3 = \frac{\gamma}{g} \pi b a^2 \frac{\rho_x}{12} w^2,$$

therefore ρ_x, the distance to the center of gravity of half the volume from the ordinate axis, will be

$$\rho_x = \frac{4}{\pi} a$$

and similarly

$$\rho_y = \frac{1}{8} b,$$

ρ_y being the distance to the center of gravity of the volume from the abscissa axis.

These formulas state that the center of gravity of half the figure generated by the curve and asymptote, rotating around the ordinate axis, is located on the distance $\frac{4\,a}{\pi}$ from the ordinate axis and on the distance $\frac{1}{8} b$ from the abscissa axis. The figure being symmetrical, the center of gravity of the whole figure will, of course, be located on the abscissa axis the distance $\frac{1}{8} b$ from origo.

The above laws relating to the location of the center of gravity do not appear to be of immediate necessity for finding the centrifugal stresses in the body in question, but they have enough bearing on the subject to be properly recorded in this connection.

	$\frac{d}{D}$	0 Solid disk.	1 8	2 8	3 8	4 8	5 8	6 8	7 8	1 Thin band.
Body of even Thickness.	R	4.	4.56	5 24	6.06	7.00	8.08	9.32	10.56	12.
	$\frac{R}{g}$	0.125	0.143	0.164	0.190	0.219	0.252	0 289	0.330	0.375
	R_1	0.000343	0.000392	0.000448	0 000519	0.000599	0 000692	0.000798	0.000904	0.00103
Tapering Section.	T	2.	2.60	3.36	4 34	5 50	6.86	8.26	10.12	
	$\frac{T}{g}$	0.062	0 081	0 105	0 135	0.172	0.214	0.268	0.316	
	T_1	0 000171	0.000223	0.000288	0.000371	0.000471	0.000587	0.000707	0 002866	

TABLE OF VALUES OF COEFFICIENTS R, $\frac{R}{g}$, R_1, T, $\frac{T}{g}$ AND T_1

Substituting the periferal velocity V for the angular velocity w in equation (18) it becomes

$$C = 192 \frac{\gamma}{g} V^2 b a^3 \qquad (19)$$

and dividing this strain by the number of square inches in the normal section, $A = 2\,a\,b$, we get the stress per square inch

$$S = \frac{C}{A} = 95 \frac{\gamma}{g} V^2 \times \frac{a^2}{D^4} \qquad (20)$$

from which equation it is seen that the strain per square inch of section decreases with the square of the ratio $\frac{a}{D}$. This ratio will, however, soon find a limitation on account of practical considerations, because, for D large compared with a, the disk becomes thin at the perifery and will finally thin out to a mere line. As the disk is required to have a certain thickness at the rim, the diameter D cannot be made much over 8 to 9 times a, depending somewhat upon the ratio $\frac{a}{b}$. The thickness of the disk at the radius $4\,a$ is always $= \frac{b}{54}$ and varies thus directly with the width b at the hub, so that the larger b is made, and the smaller a, suiting a given diameter, the smaller will S be.

If these ratios are adopted:

$$\frac{D}{a} = 8 \quad \text{for} \quad a = b,$$

$$\frac{D}{a} = 9 \quad \text{for} \quad a = \frac{2}{3} b,$$

equation (20) becomes

$$S = 1.5 \frac{\gamma}{g} V^2 = 0.047\ \gamma V^2 \qquad (21)$$

for $a = b$, and

$$S = 1.2 \frac{\gamma}{g} V^2 = 0.037\ \gamma V^2 \qquad (22)$$

for $a = \frac{2}{3} b$,

which formulas expressed in numbers of revolutions and in the outside diameter of the wheel in feet, give:

$$S_1 = 0\ 000128\ \gamma\ n^2\ D_f^2 \qquad (23)$$

for $a = b$,

$$S_1 = 0.000109\ \gamma\ n^2\ D_f^2 \qquad (24)$$

for $a = \frac{2}{3} b$.

Equations (21) and (22) compared with (13) show that wheels of sections outlined by logarithmic curves of the form $y = \log. x$ and $y = 2 \log. \frac{x}{3}$ are, respectively, 25 per cent. and 30 per cent. stronger than one of conical section.

The preceding formulas are derived by taking account of the forces which act upon the entire figure from $x = o$ to $x = \infty$, the cutting away therefore of the part of the rim between the radii $x = 4\,a$ or $x = 4\frac{1}{2} a$ and $x = \infty$ will of course affect the results somewhat.

Cutting away the rim to the radius $4\,a$ involves the following reductions: The area of normal cross-section is reduced by 1.9 per cent.; the volume of the figure is reduced by 8.3 per cent.; the centrifugal force is reduced by 12.5 per cent., and the stress per square inch section is reduced by 10 per cent.

The discrepancy in the formulas for the stress per square inch of section, due to this reduction in the actual volume, will in practise probably be made up by some details in connection with the construction, wherefore the formulas will be most useful as they stand, without any correction for the cutting away of a certain part of the rim which belongs to the *theoretical figure*. If such a correction is made, however, the coefficients 1.5 and 1.2 of the formulas (21) and (22) will be reduced to 1.35 and 1.1, respectively.

The formulas necessary for the solution of all the common problems relating to centrifugal stresses in bodies of various forms are, by the use of the table, reduced to the following simple ones:

Body of even thickness:

$$S = \frac{R}{g} \gamma V^2 \qquad (8)$$

$$S_1 = R_1 \gamma n^2 D_f^2 \qquad (9)$$

Body of straight tapering section:

$$S = \frac{T}{g} \gamma V^2 \qquad (14)$$

$$S_1 = T_1 \gamma n^2 D_f^2 \qquad (15)$$

Body of logarithmic section of form $y = \log. x$:

$$S = 1.5 \frac{\gamma}{g} V^2 = 0.047 \gamma V^2 \qquad (21)$$

$$S_1 = 0.000128 \gamma n^2 D_f^2 \qquad (23)$$

Body of logarithmic section of form $y = 2 \log. \frac{x}{3}$:

$$S = 1.2 \frac{\gamma}{g} V^2 = 0.037 \gamma V^2 \qquad (22)$$

$$S_1 = 0.000109 \gamma n^2 D_f^2 \qquad (24)$$

where

S and S_1 = strain per square inch,
γ = weight of the material per cubic inch in pounds,
D = diameter of the revolving body in inches,
D_f = diameter of the revolving body in feet,
V = periferal velocity,
n = number of revolutions per minute.

It is thought that the best way to show how these formulas may be applied practically is by a set of examples.

Example 1: With what periferal velocity can a ring of nickel steel (elastic limit 100,000 pounds per square inch) of diameters as shown in Fig. 6 revolve, with a factor of safety of 2?

Formula (8) is $S = \frac{R}{g} \gamma V^2$ and according to the table, $\frac{R}{g} = 0.289$ for a ratio of diameters $\frac{d}{D} = \frac{3}{4}$. Inserting this value, the values of $\gamma = 0.28$ and $S = 50{,}000$, the equation becomes:

$$50{,}000 = 0.289 \times 0.28 \times V^2$$

from which we get

$$V = 790 \text{ feet per second.}$$

Example 2: What is the limiting safe periferal speed of a gray-iron band wheel, the influence of the arms not considered?

Allowing a stress of 1,000 pounds per square inch, finding in the table $\frac{R}{g} = 0.375$ for a thin band and inserting these values in formula (8) it becomes:

$$1{,}000 = 0.375 \times 0.26 \times V^2$$

or $V = 100$ feet per second, or 6,000 feet per minute.

Example 3: (1) How many turns per minute, and (2) what periferal speed in feet per second would be the limit for a solid 8-foot circular steel disk of a section as Fig. 7, allowing a stress of 20,000 pounds per square inch of section. (3) How much would it weaken it to bore a hole in the center 1 foot in diameter, and (4) how does its strength compare with that of a tapering disk, as shown in dotted lines in the figure, with and without a hole in the center?

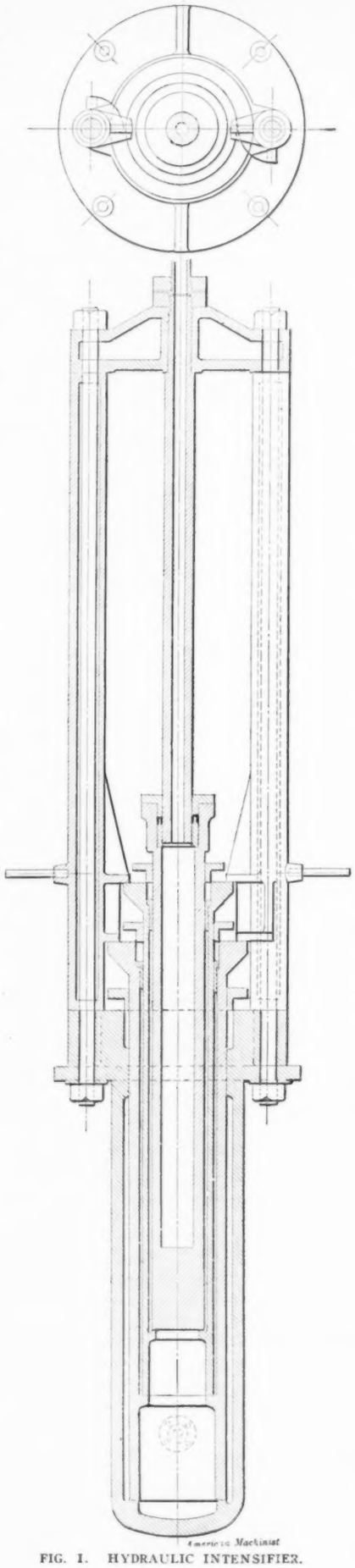


FIG. 1. HYDRAULIC INTENSIFIER.

(1) For the number of turns per minute use formula (9)

$$S_1 = R_1 \gamma n^2 D_f^2$$

As the disk is a solid one $R_1 = 0.000343$, giving

$$20{,}000 = 0.000343 \times 0.28\, n^2 \times 64$$

or $n = 1{,}800$ turns per minute.

(2) For the periferal speed use formula (8)

$$S = \frac{R}{g} \gamma V^2$$

giving

$$20{,}000 = 0.125 \times 0.28\, V^2,$$

or $V = 755$ feet per second.

The table shows directly that by boring out a hole in the center of the cylindrical disk, of a diameter of one-eighth of the outside diameter of the disk, the strength will be decreased to $\frac{125}{143} = 0.87$ of the strength of the solid disk, or (3) the strength will be decreased 13 per cent. The table shows also (4) that the solid disk of even thickness has a strength of only $\frac{2}{4} = \frac{1}{2}$ of the strength of a solid disk of straight tapering section, and that it has a strength of $\frac{81}{125} = 65$ per cent. of the strength of a disk of straight tapering section, the center of which is bored to a diameter one-eighth of the outside diameter. This will be evident as the relative strengths of the disks are of course in proportion to the inversed values of the stresses per square inch, and the stresses per square inch at a fixed speed are in a direct proportion to those figures given in the table which apply in the different cases.

Example 4: What would be the limit for the periferal speed if the sectional outline of the wheel in the foregoing example was made to a logarithmic curve, (1) starting at the center at 45 degrees to the axis, (2) starting at 34 degrees to the axis?

(1) Formula (21) for a logarithmic seciton is

$$S = 0.047 \gamma V^2,$$

therefore $20{,}000 = 0.047 \times 0.28\, V^2$, or $V = 1{,}240$ feet per second.

(2) Formula (22) for a logarithmic section is

$$S = 0.037 \gamma V^2,$$

from which $20{,}000 = 0.037 \times 0.28\, V^2$, or $V = 1{,}414$ feet per second.

By the foregoing examples may be verified the often disputed question about what the limit of periferal velocity is for a wheel of the De Laval type; one side asserting that 600 feet per second would be the limit, while the other side claims a much higher velocity. By Example 1

it will be judged that the limit for a wheel built with a separate ring around the outside of the buckets would probably be about 600 feet per second, but for a solid wheel of a curved section, with the buckets inserted at the perifery and with no ring, the limit could be extended, according to Example 4, to 1,400 feet per second, or further.

Notes on the Design of Hydraulic Intensifiers.

BY G. E. FLANAGAN.

Fig. 1 shows a three-stage hydraulic intensifier. A two-stage machine is similar in design but with one of the intermediate cylinders omitted, while a single-stage apparatus consists of three essential parts, viz., the outer or stationary cylinder, the fixed ram and the inner or movable cylinder.

As will be seen by reference to the figure, if water is admitted to the large outer cylinder, the small inner cylinder will be raised and the fluid which it contains expelled thru the hollow ram, and this will be done at a pressure inversely proportional to the area of its outside diameter and that of the ram, neglecting friction and the weight of moving parts. It will be noticed that the intermediate cylinders are held from moving. If water at higher pressure is desired, one or both of these may be permitted to rise; and the pressure attained will be governed by the proportion which the outside area of the largest moving cylinder bears to that of the ram, except that it will be reduced by the friction of two stuffing boxes and the weight of all the moving parts.

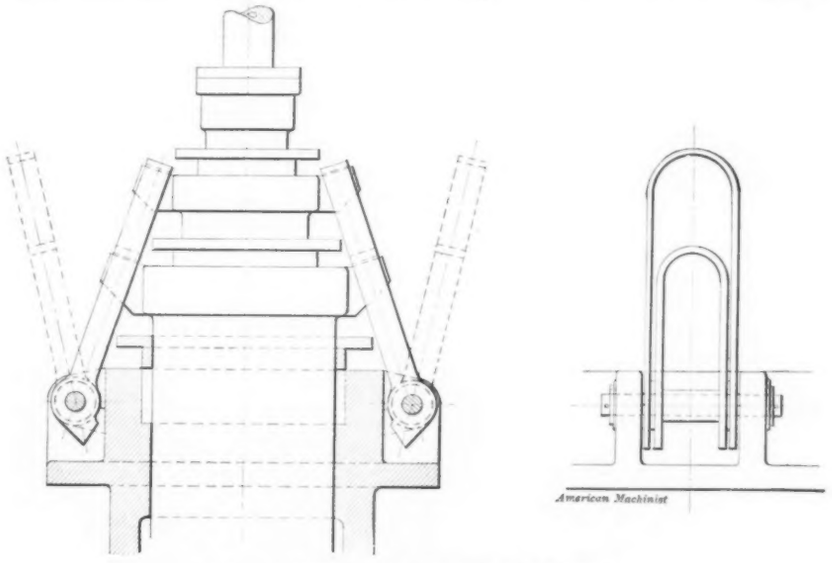


FIG. 2. MODIFIED HYDRAULIC INTENSIFIER.

On the machine illustrated in Fig. 1, a sleeve is placed over each of the tension rods, and upon these sleeves lugs are formed which hold the intermediate cylinders from rising; by turning the sleeves thru a small arc the lesser of the cylinders is allowed to move, and by giving the sleeves a somewhat greater turn, or a turn in the opposite direction, the second cylinder is also set free. It is a not infrequent practise to arrive at the same result by forming lugs directly upon the tension rods, which engage with corresponding projections upon the cylinders. In this case, when it is desired that the cylinders should rise, they are themselves rotated until their projections clear the lugs on the rods or a properly shaped ring is slipped loosely against a collar on the cylinder and the ring is rotated in place of the cylinder.

Any method which depends upon lugs directly fixed to the tension rods produces a bending moment which these rods must be proportioned to withstand in addition to their proper work as tension members, and the calculation for this combined stress will show that rods of large diameter are required. With the use of sleeves as shown in the drawing, which are clear of the rods except at each end, the bending moment is so small as to be almost negligible. In addition to this, the mouth of the cylinder may be round, and there is no objection to their turning should they develop any tendency to do so. In the case of cylinders provided with projections for the purpose of engaging with lugs on the tension rods, there is always a possibility of their working around and coming in contact with the lugs when whey they are not wanted to do so.

Fig. 2 shows a method of holding down the intermediate cylinders by means of links which connect them to the outer cylinder directly.

In case the inner cylinders are made long enough to rest upon the bottom of the outer one, as is very often done, they get to be of a length much greater than is required for the proper working of the machine. If each of the inner cylinders is made to rest upon a collar formed in the next larger one, as shown in Fig. 1, some weight and considerable machine work may be saved. Any saving in weight of the moving cylinders is an advantage in the operation of the machine, as the energy expended in moving them represents lost work, the only portion of which is restored being that necessary to overcome the friction of the stuffing boxes on the downstroke and the expulsion of the water from the outer cylinder.

The ram is made of forged steel, as is also the smallest cylinder. As these are the only parts subjected to the intensified pressure, the remaining cylinders may usually be made of gray iron. All the cylinders except the outer one are bored out their entire length to reduce the amount of clearance required. At times the proportions necessary to give the pressures required leave the walls too thin for gray iron, and steel castings are resorted to. A bronze ring which rests against a shoulder in each intermediate cylinder forms the bottom of the stuffing box, and is extended to serve as a bearing or guide for the cylinder working within it.

A leather packing held between bronze rings is shown for the innermost cylinder, where the diameter is small and the pressure high. To save wear on this packing, the ram should be highly polished and be maintained in this condition.

The upper ram is recessed to receive a gasket, usually of soft copper, and the high-pressure pipe which connects to it is turned off and enters this recess and bears firmly against the gasket, making a watertight joint of a diameter no greater than that of the pipe itself; the flanges merely serving the purpose of holding the parts together. To avoid the use of studs, bolts with their heads countersunk in the lower flange are inserted before the latter is screwed into place.

Russia's Only Building at the Fair.

Russia's only building at St. Louis, the pavilion in the Palace of Transportation, erected by the Westinghouse Company, Limited, of St. Petersburg, is representative in every feature of Russian art and workmanship, and is recognized as the general Russian rendezvous at St. Louis. The same company has furnished a small Russian kiosk in the Palace of Machinery at the head of the row of national booths erected by the different Westinghouse companies of Europe and America, and at both places, as a manifestation of Russian hospitality, Russian tea, brewed in curious old samovars, and suchari, a sweet native biscuit, are served to visitors of the company by Russian girls wearing richly embroidered boyarin costumes. The pavilion in the Palace of Transportation covers a space 20x25 feet, and is 25 feet high. It was constructed by peasant builders in the Possade Sergiewo, near Moscow, after designs by the native architect Baranowsky, who has done much important work in St. Petersburg.

Professor Bobrick's liquid air factory at Los Angeles, Cal., has been enlarged to a capacity of 100 gallons of liquid air per hour.

Turret Lathe.

The machine shown in the accompanying engravings is designed to handle bar stock up to 2⅛ inches diameter, to turn any length to 24 inches and to machine castings or forgings up to 7 inches diameter, or, where such parts do not extend over the turret, to 9 inches diameter. Front and rear views are given in Figs. 1 and 2, and a longitudinal section thru the entire machine in Fig. 3; and, as shown in these views, the spindle, which is carried by a sliding head, is rotated thru

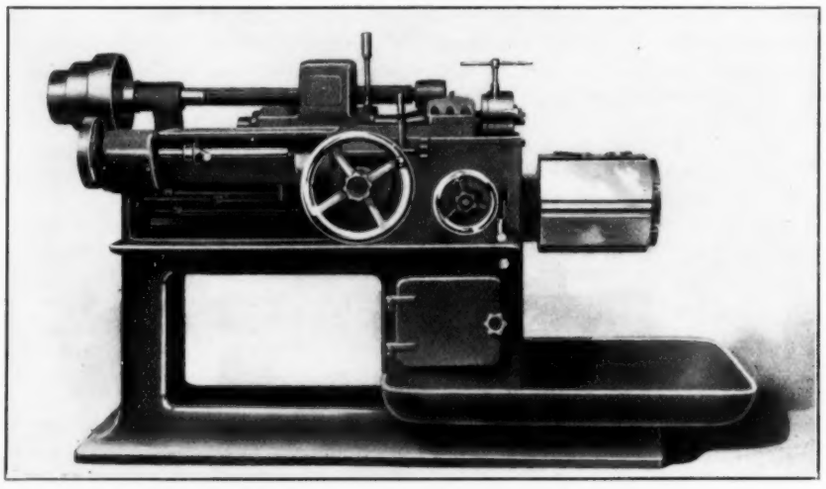


FIG. 1. FRONT VIEW OF TURRET LATHE.

bronze and steel gearing from a long pinion driven by a three-step cone pulley.

Fig. 3 gives a good idea of the spindle proportions, shows the recess and thread for receiving spring collets, or a face-plate stem, and illustrates the arrangement of the gearing by which two spindle speeds are derived from each speed of the driving pinion. It also shows the rack and pinion giving the head a travel of about 25 inches for in this construction the spindle and stock are fed to the tools rather than the tools to the work. The feed pinion is actuated, to traverse the head in either direction, by worm gearing, the driving shaft for which may be operated at four different rates of speed thru the medium of a gear box which is attached to the front of the bed and whose mechanism is driven by the plain pulley located as represented in Fig. 1. The large hand-wheel in the latter view traverses the spindle slide independently of the power feed; the small wheel immediately to its rear gives a slow hand feed; and the lever with forked end passing over the feed shaft controls the gearing by which the four feed changes are secured.

The small wheel at the front of the bed is for rotating the turret by hand to give the tools a cross-feeding movement when forming, facing or recessing work. Ordinarily the turret is indexed by power thru the belt pulleys, friction, shaft and gearing carried at the rear of the bed as in Fig. 2, the bevel gear shaft which passes thru the bed driving by worm and gear a shaft with a pinion adapted to engage with an internal gear attached as shown in Fig. 4 to the turret. The latter is prevented from rotating except at the proper time by a stop bolt and pin arranged as clearly indicated in the cross-section. The bolt is withdrawn by a lever extending thru an opening in the bed and attached to a rock shaft, which shaft has at its outer end a pinion meshing with teeth formed on the under side of the bolt. The turret itself is 14 inches long, admitting of two or more tools being used on one face if desirable,

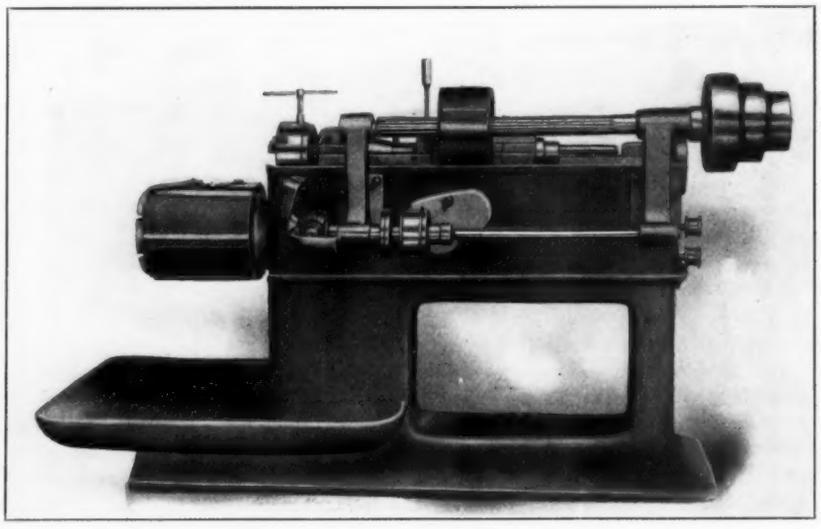


FIG. 2. REAR VIEW OF TURRET LATHE.

as in Fig. 5, and is mounted on a large taper hub at the end of the bed as in Fig. 3, the hub carrying also a stationary face-plate to which drilling or other special attachments may be bolted.

A lantern of stop bars, arranged and operated as shown in the engraving just referred to, carries for each face of the turret two independent stops by which the power feed in either direction may be released and the spindle slide stopped at the required points.

The driving cone for this machine takes a 3-inch belt and is 12 inches diameter on the largest step; the ratio of the gearing between cone and spindle is 3 to 1 and 12 to 1. With a two-step countershaft the twelve spindle speeds should range from 20 to 200 turns per minute. The bed of the machine, as will be noticed, is provided at one end with a large chip pan draining into an oil reservoir from which lubricant may be pumped to the work, and has also a convenient cabinet for tools.

The inventor and designer of this turret lathe is L. H. Blood, Waterbury, Conn.

Application of Scientific Methods to the Labor Problem.*

BY H. L. GANTT.

The greatest problem before engineers and managers to-day is the economical utilization of labor. The limiting of output by the workman and the limiting by the employer of the amount a workman is allowed to earn are both factors which militate against that harmonious co-operation of employer and employee which is essential to their highest mutual good.

Scientific investigation is rapidly putting at our disposal vast amounts of knowledge concerning materials and forces, which it is the business of the engineer to utilize for the benefit of the community. Well-designed plants and efficient labor-saving devices that are to be seen on every hand bear testimony that he is doing at least a portion of his work well. When, however, it comes to the operation of these plants and the utilization of these labor-saving devices, the lack of co-operation between employer and employee and the inefficient utilization of labor very much impairs their efficiency. The increase of this efficiency is essentially the problem of the manager, and the amount to which it can be increased by proper study is, in most cases, so great as to be almost incredible.

In considering the subject of manage-

*A paper read before the International Congress of Arts and Sciences at the St. Louis World's Fair.

ment we must recognize the fact that, in this country, so long as a man conforms to the laws of the State he has a right to govern his own conduct and to act in such a manner as his interests seem to dictate. Granting this, it follows that any scheme of management to be permanently successful must be beneficial alike to employer and employee, and neither labor unions that regard their interests as essentially antagonistic to that of employers, nor employers' associations whose only effort is to oppose force with force, can ever effect a permanent solution of the problem of the proper relations between employers and employees.

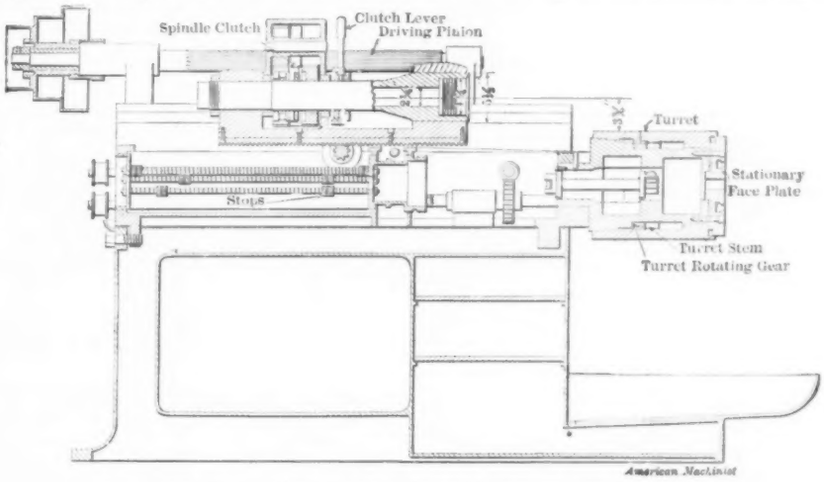


FIG. 3. SECTION THRU SPINDLE, TURRET AND BED.

Boards of arbitration are temporary expedients, and the results of their work are seldom better than a sort of Missouri compromise, to be fought out later; for, altho they be composed of men of the highest intelligence and of the greatest integrity, the conditions under which they are organized and the means at their disposal never enable them to get more than a superficial knowledge of the subject. The information such a board gets is all in the form of testimony, which, altho it may be honestly given, can never produce a complete understanding of the subject, for, as a rule, neither employer nor employee knows exactly in detail the best way of doing a piece of work, and, as far as the writer's experience goes, they *never know exactly how long it should take a good man fitted for the work and provided with proper implements.* Before intelligent action can be taken in any case, these facts must be known.

In order to get a general idea of the conditions that exist in the mass of our manufacturing industries it is necessary to review briefly the manner of their development.

The expert mechanic who, with a business growing to larger proportions than he could take care of, hired a few men to help him, and directed them all by his personal example and skill, first gave place to the small factory which he could run on the same lines. To-day, however, even the smaller factories have grown beyond the point where they can be directed or controlled by one man, and methods which were successful on the smaller scale fail now to apply on the larger. The factory is divided into departments, each directed by a foreman who in many cases has had no training in management and oftentimes has no capacity for it. He is invariably overworked if he attempts to do his duty and the manager seldom has time to inquire into his troubles, but frequently tries to remedy matters by appointing another foreman, often making matters worse.

Again, if expenses are too great, and it seems impossible to meet competition, there is seldom any serious effort made to find out why expenses are too high, but it is assumed that the way out of the difficulty is to reduce wages. It never appears to occur to a manager that perhaps the cause of the excessive expense may not lie with the workman, but with the management. Managers rarely seem to suspect that, if the workmen were more intelligently directed, the output per man might be largely increased without a corresponding increase in expense.

Those who have given even superficial study to the subject are beginning to realize the enormous gain that can be made in the efficiency of workmen if they are properly directed and provided with proper appliances. Few, however, have realized another fact of equal importance, namely, that to maintain *permanently* this increase of efficiency the workman must be allowed a portion of the benefit derived from it.

To successfully obtain this high degree of efficiency, however, the same careful scientific analysis and investigation must be applied to every labor detail as the chemist or biologist applies to his work. Wherever this has been done it has been found possible to reduce expenses and at the same time to increase wages, producing a condition satisfactory to both employer and employee.

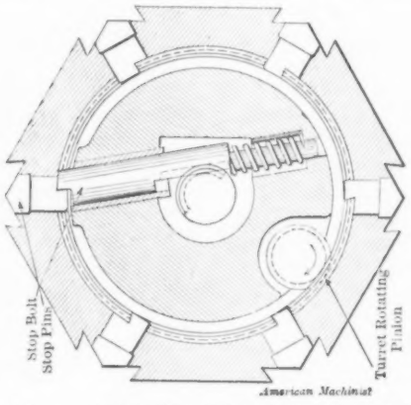


FIG. 4. SHOWING TURRET SECTION, LOCK BOLT AND ROTATING GEAR.

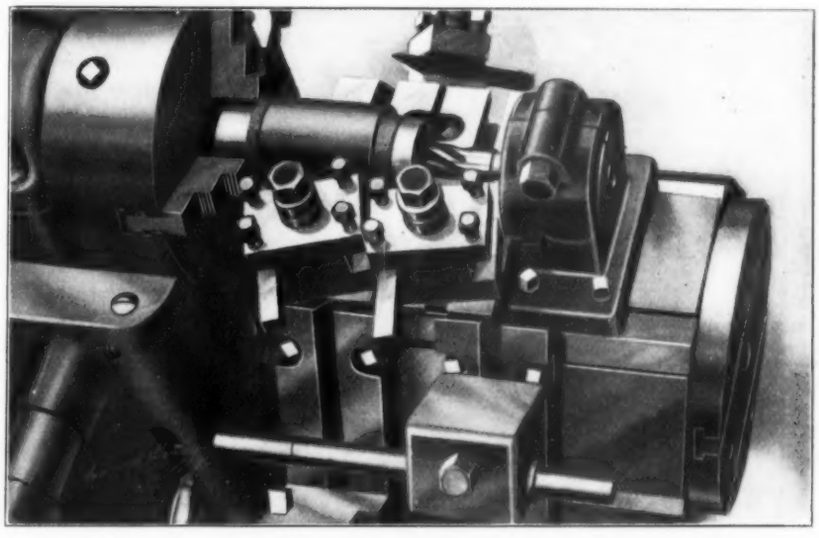


FIG. 5. TURRET TOOLS IN OPERATION.

The great difficulty in instituting this method of dealing with labor questions is that usually neither employer nor employee has sufficient knowledge of the scientific method to realize either the amount of detail work necessary, nor the extent of the benefits to be derived from it. In general, their inclination is to adhere to the methods with which they are familiar, and to distrust all others, even tho their

methods have failed to bring them appreciably nearer the solution of their problems, and the newer methods have produced results far more satisfactory than they even hope for. A scientific investigation into the details of a condition that has grown up unassisted by science has never yet failed to show that economies and improvements are feasible that benefit both parties to an extent unsuspected by either.

The scientific laboratory for the study of materials and forces originally considered as belonging only to educational institutions has recently become a recognized necessity in all our large industries, and to it principally the great advance of recent years has been due. As yet, however, in but few cases has any definite attempt been made to study in a scientific manner the most efficient way of utilizing the human labor. Of how much work of various kinds the ordinary man has done, we have many records, but of how much a man specially suited to any class of work can do, we have almost no knowledge. Enough study has been spent on the subject, however, to determine that men specially suited to any particular kind of labor, if supplied with proper implements and intelligently directed can do on the average at least three times as much as the average workman does if the limiting factor is physical exertion and, if assured sufficient compensation, will do so day after day.

The ratio of what can be done to what is done is even greater than three to one in work requiring skill and planning. Well thought out plans accompanied by complete instructions for doing work by the best methods known often produce an increase of more than 100 per cent. over what is usually done; for complicated work, which should be planned most carefully, is often not planned at all but left to the judgment of a foreman whose first knowledge of what is to be done reaches him with the order to do it. In such a case it is the exception when the work does not cost in wages at least four times what it should, and this with no fault of the foreman or workman.

These facts have been established in numerous cases of ordinary labor, in doing machine-shop work, in building engines, and in the erection of structures of various kinds. Similar possibilities have been indicated wherever the slightest effort has been made to study or to plan, showing that in many instances a condition of affairs which is not only wasteful to the owners but discouraging and unjust to the workmen, most of whom would be willing to do more work to earn increased pay if only the opportunity to do so were offered, and they were guaranteed that they would not ultimately lose by doing so.

Mr. E. F. Du Brul, until lately the commissioner of the National Metal Trades Association, an organization of employers formed to protect themselves from the unjust demands of the labor unions, stated not long ago that a large majority of strikes were produced by mismanagement. Mr. Du Brul has, perhaps, had more general experience recently with striking employees than any other man in this country, and his conclusion is that the best insurance against strikes is good management. He therefore strongly advises managers to study the subject.

The necessity for this advice will become evident when we realize that hardly any two managers, unless they have been trained under the same influence, agree as to the proper way of dealing with any of the intricate questions that are constantly arising between employer and employee, much less will they agree on any general principles of management.

There have been in the past, and are to-day, great managers. Are there not some general principles by which they either consciously or unconsciously are governed?

In other words, are there not some general principles, applicable at least to a large number of cases, according to which substantial equity can be insured between employer and employee, and a higher degree of efficiency realized from their harmonious co-operation?

The only successful method of determining general laws has been that of scientific investigation, and, in the study of questions involving human labor, enough has been done to show that the same method is applicable to at least a large number of individual cases, and there is good reason to believe that it is universally applicable.

Labor unions demanding all they can get, and employers associations organized to oppose the demands of the unions, can never evolve a satisfactory system of management, for altho each in its way may be, and undoubtedly is, often beneficial to its members, both are formed with the idea of using force only, which can never be a substitute for knowledge. Altho a board of arbitration may be useful in averting a crisis, the decision of such a board founded on such facts as are available should be professedly only temporary in character, to be revised later according to the results of a scientific investigation of the matter in dispute, to be undertaken at the earliest possible date.

This problem consists of three parts:

First—To find out the proper day's task for a man suited to the work.

Second—To find out the compensation needed to induce such men to do a full day's work.

Third—To plan so that the workman may work continuously and efficiently.

The first part of the problem is the difficult part, for a man suited to the work must be found and induced to work at his full capacity. The details of the work must be arranged so that he can work most efficiently, and the time to do each detail must be carefully studied with a stop-watch.

From such detail observations it is possible to determine what a good man can do every day, and there is but little difficulty in finding out what men have to be paid to make them do all they can, for altho men prefer, as a rule, to sell their time, and themselves determine the amount of work they will do in that time, a very large number of them are willing to do any reasonable amount of work the employer may specify in that time, provided only they are shown how it can be done and guaranteed substantial additional amounts of money for doing it. The additional amount needed to make men do as much as they can depends upon how hard or disagreeable the work is, and varies from 20 to 100 per cent. of what they can earn working by the day according to their own methods and at their preferred speed.

The cost of such investigations is necessarily large, for they can be made only by capable men who have had the special training necessary, and hence the expense must be borne by the employer; but the returns, when the results of these investigations begin to be applied, are in a short time so great as to pay for the investigations, allow a substantial increase of wages to the employee and leave a good margin of profit to the employer.

The benefits which have been derived from such investigations are:

An increase of output.

A decrease in cost of product.

Better workmen attracted by higher wages.

Improvement of quality of product due to better workmen and more careful supervision.

These results are well worth striving for, and the fact that they have been obtained by the application of the scientific method to the ordinary problems indicates strongly that progress is to be made in such matters by the same methods that have been responsible for other kinds of progress in the past.

This detailed study of the elements of every labor problem was first made by Mr. Fred. W. Taylor, who for over twenty years was the only man to apply the scientific method rigidly to this subject, and to-day the people doing this work most thoroughly are those that have been trained under his influence.

There are to-day in this country at least 20,000 employees whose tasks and compensation have been directly influenced by such study. They are all doing more work and earning more money than those engaged in similar work under the old methods, and there has never been anything in the nature of a strike among them.

Patrick C. Condon, a machinist, of Salem, Washington county, N. Y., employed by the General Electric Company at Schenectady, has been nominated for State Senator. It is to be hoped that if he is elected he will line up and oil up and otherwise improve the running of "the machine." It makes too much noise and does some bad work.

Echoes From the Oil Country—Patternmaking in a Small Shop.

One of the men who has taken part in the progress of events in this section has ren inded me that there is one part of the establishment that has not had much attention from me.

He is a patternmaker. After being with us for a number of years he left because he felt that the world was large and that we were small. Being without experience in the large world, he thought that his opportunities to learn would be somewhat in proportion to the size of the world if only once he got into it. Now he has an opinion that many small places have opportunities out of all proportion to their size. After an experience of several years in this big world he has come to the conclusion that it is a much harder test of a man's ability for him to hold a job in the little place than it is in the big place; indeed he says that there are many in the big shops who view with incredulity his accounts of the regular duties of a patternmaker in the sma l shop which only keeps one..

I think I can give a pretty accurate description of how things used to go at the time when Charley was "the whole thing" in a certain shop in this neck-of-the-woods. Around these little "one-horse" establishments, it will be understood, the pattern shop is simply the place where wood is worked. The patternmaker is a man who works wood. Naturally it follows that if there is any work to be done on wood the patternmaker is the man who should do it. If the job cannot be readily taken to the patternmaker, the patternmaker can go to the job. It is an exceedingly poor man who knows only enough to do one class of work in wood. Charley was not in that class, as the following will show.

Charley is working on a pattern for a party "up the creek," and is trying to figure out from the drawings "the best way to make the blooming thing" so that it will please the owner and suit the various molders that may chance to use it, and at the same time be a money maker for the boss and a reputation maker for himself.

To do the first it must be cheap, "for a pattern." To do the second it must take the least possible expenditure of labor and skill to produce a good casting. To do the third the boss must be able to add a fair per cent. to the cost without raising a protest from the man who has it to pay for. A failure in any of the foregoing and he has not added to his general reputation; and, more than that, if this pattern goes to pieces or gets all out of shape, even people with poor memories will remember who it was that made it.

Yes, boys, he has a nice light place to work in, and the shavings he makes do not soil the clothes. He does not seem to know all of the troubles of the molder, nor all the machinist's either, but believes he has a few troubles of his own. He is not always allowed to work and think in peace. Sometimes he is interrupted.

"Charley, just let that stand for a while, and come with me. A roof is needed over the place where we are cleaning the castings. We have spread out so much inside that the men have had to do the cleaning out of doors, and now it is getting along to the time of year that we must expect some bad weather. We will have to get a roof on before it comes. It is not in any great rush, but you can see where it has to be and then plan it so you can get it in without letting it interfere with your regular work."

The Old Man is giving Charley the outlines of a little filling-in job that has come to his mind. Now it is off his mind, and Charley can "do it anytime"; that is, he can if he does it at once. Those casting cleaners know that it is going to be done, and each one of them (Charley will be very glad for a while that there are only two of them) will appoint himself a special committee to find out just when the work is to be started and how long it is going to take. Every time a cloud appears in the sky they will have immediate fears of a deluge and will of course tell of the danger at every opportunity. It is surprising, too, how very, very hot the sun is—much hotter than it was before they knew they were to have a roof. Charley may get partly even by borrowing them and using them as helpers in putting on the roof.

"Make me up a lot of sojers and some wedges for clamping up, and I will need a flask 18 inches wide and 33 inches long. The cope will have to be 13 inches deep, and barred up strong, and the bars cut away to suit this pattern. You can see from the pattern what kind of a drag I will have to have. I've got to have it the first thing in the morning, so don't you forget it or let anything else crowd it out."

Not much need to tell you the boss molder is having his innings.

"Say, Charley, Tom sent me up to see if you have that shipper rod done. He says it wasn't much use your putting up the countershaft if you wasn't going to make the shipper. Says you might just as well have made the shipper and left the countershaft down, as far as running the lathe goes. Hank gave me this hammer as I came along, and he wants a handle put in it right off. He said, 'Tell that chump for goodness' sake not to put it in as crooked as he did the other one, and tell him to throw it down when he gets the handle in,'" and the boy from the machine shop laid a hammer with the stub of a handle in it on the bench.

"Did he tell you to come up and talk like that?" and Charley looked sharply at the boy. "If he did, you tell him to come up here a minute and I will throw him down instead of the hammer. If you made it up yourself, I ought to throw you down."

The boy got close to the stair before he answered, and then he remarked: "I didn't make nuthing up, but everybody knows that you don't know how to do anything very good," and he ducked quickly down to avoid the possibility of being hit with a block.

"A man broke thru the floor down by the big lathe" (a monster of 28-inch swing, by the way). "You will find the hole there in front of it, and between the drill press and the grindstone. It is at a place where the men pass along very often. Drop everything, and fix it before some careless fellow drops thru and perhaps breaks a leg." The foreman of the machine shop evidently thinks that this is something of importance. He evidently knows that it is not safe to take any chances with some of his men, and acts accordingly.

Charley takes a piece of board in his hand to cover the hole until he can get time to make more durable repairs. He throws the hammer with the new handle in it, none too gently perhaps, toward Hank, after he has used it to nail the board down. Before he gets upstairs again he is headed off by the teamster, who wants some repair on his wagon box, and at the same time a man rushes in from the foundry to tell him that he is wanted in a hurry to put some overhead bracing to the supports of the foundry crane.

That call does not please him a bit. He knows too well what it means to crawl up on those beams, all covered with foundry dust, and to get eyes, mouth and hair full; to saw, and bore, and chisel among the bolts and nails and have a lot of damaged tools to fix up afterward, and all the time having some fellow down below yelling up wanting to know how long it will be before he can use that crane.

"Hello, Charley. Are you very busy?" He hasn't near all of the dirt cleaned off from the last job yet. He hasn't had time. "Because if you are not, there is a little work in the office that needs looking to. We don't want to rush you too hard, but the quicker you get it done the sooner you get us out of our misery."

Charley is humane and wants to know what is wanted in that direction. He is on good terms with the office force, and this is the head bookkeeper who is talking to him.

"We need a cupboard where we can keep our supply of office stationery. We find it is much cheaper to buy it in larger quantity than we have been doing heretofore, and haven't drawers enough to hold it. While you are at it, put up some hooks in the closet, and I noticed that there is a bad plank in the sidewalk that needs looking after. There is a loose one, too, that better be made safe at the same time. It tipped up and tripped a fellow a little while ago. He wasn't hurt, but he did some tall cursing just the same."

The foregoing will show that Charley

had a few divertisements thrown in along with the serious work of making patterns and keeping them in repair. It does not by any means comprise the full list, as in certain seasons there were screen doors and windows to put on, saws to file, and it was quite a standing job for him to have to do some repairs on the felt roof that covered the pattern shop.

It used to puzzle him somewhat, at first, to know who was in authority over him and his work, but he finally saw that he was supposed to be the head of everything wooden about the place, and so it was very natural that these jobs were referred to him. As his help was very limited he had to do them himself. He was not made of the kind of stuff that would let the work be held back because of the inability of his department. It wasn't much of a department when Charley first knew it, but it got bigger before he left it.

Do not imagine because of the variety of the work that came his way, that this was the kind of a job where a man was driven to death, and had to overwork to be able to hold his job. It is true that sometimes it was necessary for a man to do his very best to get a job out quickly, and sometimes they poured in all in a bunch, so that it was hard to know which one to do first; but when the work got so that it was too much for one man to keep up, another one was put on. He was a carpenter, who had the rough work to do. He was under the directions of the patternmaker, who was thoroughly competent to tell him how to fix the gate, make templets, build a fence, put glass in the windows, fill, stain and varnish office furniture, or, if need be, to *show* as well as tell how on these or any other little things with which the other might not be familiar.

When the pattern shop began to be supplied with machinery it was necessary for him to learn all about keeping it in proper shape for use. He did not always have a man who could do this, neither did he always have one who could run a gas engine; but when the shop got too large for its old quarters the new shop had its own power, and that power was a gas engine. He did not think, when he was struggling to keep that engine going without having to call on the machine shop, how useful the knowledge would be some time afterward when he was boss patternmaker for a concern making gas engines.

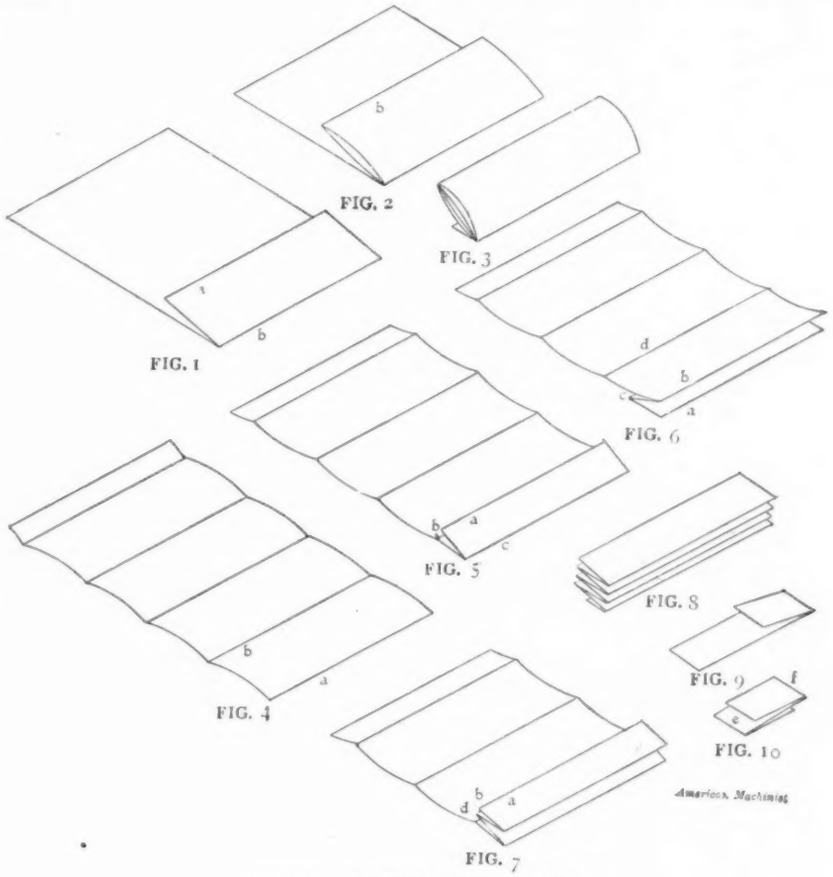
In his changing around I do not think he has found that any of his experience in the little shop was detrimental to him.

W. Osborne.

The weight of a cubic foot of Portland cement concrete is from 130 to 140 pounds, a cubic foot of iron or steel weighs about 480 pounds; these being now our most important building materials, these items of knowledge are of frequent and diverse application, so that it will hurt nobody to have them handy.

The Accordion Fold for Drawings and Tracings.

The accompanying sketches show a method of folding drawings and tracings which has been adopted by the Pennsylvania Steel Company for folding the many sheets which pass between the office and works. Its advantages are that the final size can be determined in advance and that whatever the size of the sheet it may be folded to fit a given envelope. Moreover, unfolding and refolding are so simple and obvious that the sheets are naturally refolded in the same manner as at first, the creases not being folded back on each other, as is too often done, rather than puzzle out the original method of folding.



FOLDING DRAWINGS AND TRACINGS.

Referring to Fig. 1, the end of the sheet is first folded over, the width *a b* of the fold being twice the width of the envelope. The edge *a* is then folded in and another fold made as in Fig. 2, the folded part being turned over and over until the entire sheet has been folded, the appearance being then as in Fig. 3. The sheet is now unfolded and presents the appearance of Fig. 4. Next it is turned over and the edge *a* is folded even with the crease *b*, as shown in Fig. 5. Edge *c*, Fig. 5, is then turned under as in Fig. 6 and edges *a* and *b* are folded even with crease *d*, as in Fig. 7. This process is repeated until the entire sheet is folded as in Fig. 8. Pressing the folds flat, one end is turned up as in Fig. 9 and the other down as in Fig. 10, the entire length *e f* in Fig. 10 being that of the envelope.

If our readers will fold a piece of paper in this way, they will find two corners exposed in the final form, and by taking hold of these corners and pulling gently the entire sheet will with one motion unfold like an accordion. The method of folding is due to Mr. S. W. Baldwin.

Demands for Technical Education.

Petitions will be presented to the Legislature this year for the establishment of technical schools for the shoe trade in Brockton, Lynn and Haverhill, and the argument which will be used in favor of the proposition is that a precedent has been established by the founding of textile schools in New Bedford, Lowell and Fall River. From this it is easy to see that every city or town will eventually demand a technical school to teach some trade, and the advocates of the technical schools for the shoe trade are already advocating leather schools as well as shoe schools, pointing to the deserted tanneries throughout New England as reminders of a lost industry which might be recovered. The making of leather is a chemical process and is no longer dependent upon hemlock and the forests. There are technical leather schools in Germany, and since Germany has secured the business which England once enjoyed, the English are already establishing schools to recover the

trade. It is not a far cry to technical schools to educate the youth in all the trades.—*New Bedford Mercury.*

Calculating Cone Steps and Back-Gearing Ratios by the Slide Rule.

BY W. OWEN.

Being actively interested in the design of machine tools, and seeing Mr. Bruce's article on the above subject at page 1090, I beg to make a few observations thereon. I consider Mr. Bruce's method to be the most up-to-date manner of solving the problem that has appeared in the AMERICAN MACHINIST, because it aims at a graphical solution; but not being what I may term thoroughly graphical in its application, it is cumbrous.

The basis of his reasoning—that equal spaces stepped off on a logarithmic scale give numbers in geometrical progression, is undoubtedly correct. I may say, in passing, that I designed a logarithmic chart based upon the same reasoning, by the use of which all the necessary calculations can be made by drawing a straight line across the chart; but as this letter deals only with the application of the slide rule to the calculations, its place is not here. All the calculations can be made on the rule, but in the ordinary way, as I will presently show.

In designing any machine which is to have a series of speeds in geometrical progression, it is well known that the chances are ten to one against the first set of calculations for the gears quite suiting the practical conditions embodied in the design of the machine; therefore they may have to be repeated, with slight variations, two, three or even four times. Consider the time taken up in using Mr. Bruce's method of dividing up strips of paper three or four times. It should be remembered, too, that the number of divisions is always prime, as it will equal $N - 1$, where N is the, usually even, number of speeds the machine is to have. The divisions therefore cannot be made by continual bisection, but must be made with an inclined line.

Mr. Bruce says, as does also Mr. Vernon, at page 1790, Vol. 26, that, after having fixed the extreme speeds and the number of speeds, the next step is to calculate the intermediate ones. This, I beg to state, is an unnecessary part of the proceeding, as I will show. Mr. Vernon's ideal speed ranges and Mr. Bruce's divisions for reading the intermediate speeds are not at all required. In a set of speeds in geometrical progression, it is easily shown that

$$l = f R^{N-1}$$

or

$$R = \sqrt[N-1]{\frac{l}{f}} \qquad (1)$$

in which

l = highest speed,

f = lowest speed,

N = number of speeds.

R = ratio by which the speeds advance.

It is upon this quantity R that all the necessary calculations are based.

Leaving aside the application of the rule to the calculation of R at present, consider the case used by Mr. Bruce. If the speeds of the machine are to be reduced from 280 to 20 revolutions per minute, it is clear that the total gear [speed ratio—Ed.] must have advanced proportionately from 20 to 280 to bring about this result; or calling the gear when the machine is running at its highest speed, 1, from 1 to 14. (Note—I call it an advance of gear when the belt is moved from one step on the cone to a larger step.) This being so, the ratio by which the speeds advance must equal the ratio by which the gears advance also, still calling a change of position of belt a change of gear.

Consider the belt to be on the large step of the six-speed cone, with the back gearing in, the machine making 20 revolutions per minute. Assume the belt to be moved to the next step, thus increasing the speed by the ratio of advance, and making it equal the slowest speed multiplied by R. If the belt be moved to the third step, the speed will equal the slowest speed multiplied by R^2, and when the belt is on the smallest step, the speed will have been increased by R^5, or R^{n-1}, n being the number of steps on the cone. Therefore, after having found R, the ratio of change given by the extreme steps of the cone $= R^{n-1}$.

This result, however, has been brought about by the use of two similar cones, so that the ratio between the top and bottom steps will not be R^{n-1}, but

$$\sqrt{R^{n-1}}.$$

Therefore having found R, we have:

Top step : Bottom step :: $\sqrt{R^{n-1}}$: 1.

If the total ratio of change given by the cone $= R^{n-1}$, or in this case R^5, the ratio of change given by gearing to keep the speeds in correct progression must equal R^6, or stated generally R^n. Running down the cone again with the gearing out, we get the speeds changed by the ratios R^6, R^7, R^8, R^9, R^{10}, R^{11}.

Stated generally, the rules for a machine with one countershaft speed are these:

Knowing the extreme speeds and the number of speeds, calculate R from formula (1), when

Ratio of largest to smallest step $=$

$$\frac{\sqrt{R^{n-1}}}{1} \qquad (2)$$

First gear ratio $=$

$$\frac{R^n}{1} \qquad (3)$$

Second gear ratio $=$

$$\frac{R^{2n} \text{ or } (R^n)^2}{1} \qquad (4)$$

The rules for a machine with two countershaft speeds R being calculated are:

Ratio of largest to smallest step $=$

$$\frac{\sqrt{R^{n-1}}}{1} \qquad (5)$$

Ratio fast to slow counter speed $=$

$$\frac{R^n}{1} \qquad (6)$$

First gear ratio $=$

$$\frac{R^{2n} \text{ or } (R^n)^2}{1} \qquad (7)$$

Second gear ratio $=$

$$\frac{R^{4n} \text{ or } [(R^n)^2]^2}{1} \qquad (8)$$

Having proved the rules, I will now show how the slide rule may be used in working them out.

Taking Mr. Bruce's case of a four-speed cone with two ratios of back gears giving twelve speeds ranging from 20 to 280 revolutions per minute, from formula (1) it is clear that

$$R = \sqrt[11]{\frac{280}{11}}$$

$$= \sqrt[11]{14}$$

Set 1 on C scale to 14 on D scale, and reverse the rule, when the log. of 14, viz.: 1.146, is read on log. scale. Turn the role back again, and divide 1.146 by 11, *i. e.*, set 11 on C opposite 1.146 on D, when .104 is read on D, opposite the index of C. This is the log. of R. Reverse the rule again and set .104 on log. scale to its index, when 1.272 is read on D opposite the index of C. This quantity, 1.272, is R. Next find

$$\sqrt{R^{n-1}} = \sqrt{1.272^5}.$$

Leaving the rule in the last position, that is, with the index of C opposite 1.272 on D, and reading opposite 1.272 on B, we get the cube of 1.272; transferring this by cursor to the D scale, we read 1.432 for the value of $\sqrt{1.272^5}$. Therefore the diameter of the largest step equals 1.432 times that of the smallest step. Fixing 20 inches as the largest diameter and dividing this by 1.432 gives 13.97, or 14 inches, as the diameter of the step.

By formula (3) we find the first gear ratio to be 1.272. Setting 1 on C to 1.272 on D and reading on A by the cursor set opposite 1.272 on C, we find the value of this ratio to be 2.61. Similarly by formula (4) we find the second gear ratio to be $(2.61)^2$. Reading up by the cursor from 2.61 on D, we find 6.82 on A for the value of this ratio.

Knowing the fastest speed to be 280 revolutions per minute, it follows that the countershaft speed must equal

$$\frac{280 \times 14}{20} = 14^2$$

which the rule shows us to be 196 revolutions per minute.

I find these figures to exactly agree with Mr. Bruce's, but submit that their repetition would consume less time than would the repetition of his method.

An electric traction system twenty-four miles long is about to be established at Shanghai, China. Fearon, Daniel & Co., 96 Wall street, New York, furnish plans and receive bids.

The Fracture of Structural Steel Under Alternating Stresses.*

The efforts of steel metallurgists and engineers to obtain scientific control over the mechanical properties of steel used for structural engineering purposes, altho attended with much success, have nevertheless presented certain unfortunate features of failure. Thirty or forty years ago it was claimed, apparently with reason, that if the chemical constituents of mild steels were identical, their mechanical properties were necessarily similar. But, as experience extended, it soon became evident that steels registering practically the same chemical analyses gave astoundingly different mechanical tests. The next stage of research led to the enunciation of the generally accepted idea that steels having a good chemical composition, correlated with satisfactory tensile and bending tests, were thoroughly reliable. But the advent of high speeds placed engine parts under rapidly alternating tensile and compression stresses, the reversals being, in some instances, at the rate of 800 per minute. Under these new conditions, the sense of security insured by a good chemical composition and satisfactory static tests was rudely disturbed by the fact that steel, in a relatively small number of cases, was liable to fracture far below its elastic limit, more after the manner of glass than of a ductile metal.

These facts led to a remarkable development of the micrographic method of examining steel. The results obtained have thrown considerable light upon the matter; but after fifteen years' correlative research, the inexorable logic of facts compels the author to state with regret that in connection with this particular matter the microscope in its turn has to a considerable extent broken down in its attempt to solve that mystery of steel, of all others

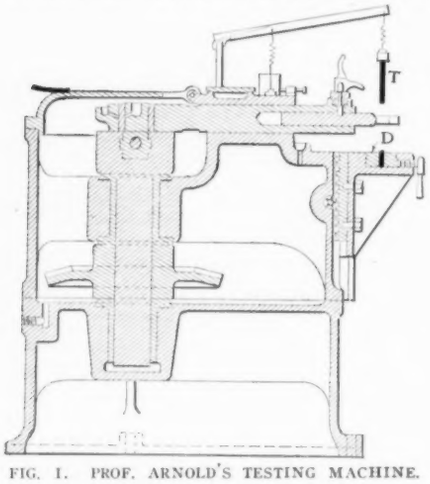


FIG. 1. PROF. ARNOLD'S TESTING MACHINE.

the most important practically, namely, the cause and prevention of its sudden rupture under vibration and alternation, two phenomena probably closely allied. The author here wishes to emphasize and reiterate the fact that he is discussing steels possessing great toughness and ductility under ordinary static tests.

To pass from generalities: The author, thru the kindness of his friend, Mr. J. T. Milton, chief engineer of Lloyd's, is enabled to publish, with a certain degree of reserve, important facts ascertained during a two years' research carried out with the assistance of his friend and colleague, Mr. Andrew McWilliam, A. R. S. M., at the University College of Sheffield, under instructions from Lloyd's committee.

To select one instance, the shell plates of the boiler of a colonial cruiser split longitudinally from end to end, under the hydraulic test. The fractured plates were about one inch thick, and each weighed nearly three tons. The average analysis of the plates was about as follows:

Carbon	0.20
Silicon	0.02
Manganese	0.50
Phosphorus	0.04
Sulfur	0.04
Copper	very low
Arsenic	very low

Of course the above analysis is beyond reproach. Pieces from the fractured plate, bent double and closed right up under violent hammering, without any sign of flaws. The average tensile tests registered about:

Elastic limit . . . . . 15 tons per sq. in.
Maximum stress . . . . 29 tons per sq. in.
Elongation . . . . 29 per cent. on 2 inches
Reduction of area . . . . . 50 per cent.

The above mechanical tests leave little to be desired. The microscopical structure showed a distinct and unusually sharp segregation of the pearlite and ferrite, the latter being angular and intensely crystallized. It was also large in pattern, and frequently occurred in those long white lines, rich in sulfur and phosphorus, which are technically known as "ghosts."

In the early stages of the research it was thought that the sharp crystallization might be regarded as an effect due to that cause which produced also the effect of brittleness. As will be seen presently, this theory was decisively negatived by subsequent experiments. In order to measure the mechanical brittleness incapable of being detected by ordinary static or bending tests, the author caused to be devised the machine represented in the full-sized diagram exhibited, Fig. 1.

The test piece *T* is along the line of the die *D* rapidly placed under severe alternating stresses, slightly beyond its elastic limit, produced by the rotation of an eccentric on the vertical shaft of the bevel wheel, but the strain along this line is necessarily relatively small. The number of alternations are registered by a counter, adjusted to zero for each test. The rate of alternation can be varied at will, and in the near future these data will be supplemented by a record of the energy expended per test piece, ascertained by means of a delicate integrating Wattmeter. This method of testing—which practically carries out the almost impracticable Wohler test in one or two minutes—has already thrown important light on the obscure phenomena under investigation, and has also exhibited remarkable delicacy. These facts are proved by the data now submitted to the section by the author.

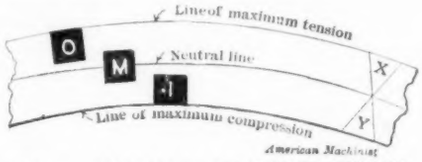


FIG. 2. DIAGRAM OF STRAINS IN BENDING BOILER PLATE.

In preliminary tests on standard English acid open-hearth boiler-plate steel the remarkable fact was noted that in all probability the resistance of structural steel to rupture under rapidly alternating stresses is inversely proportional to the rate of alternation. This law, if fully established by the exhaustive experiments now being carried out at the Sheffield College, demands careful attention from every engine designer. The following figures indicate concretely the data upon which the author provisionally enunciates the law. Table 1 has reference to alternating shock bending tests carried out on a good boiler-plate steel, the test bars being ⅜ inch square and the bending force being applied 4 inches from the line of maximum stress, with a range of 9-16 inch each side.

Mark.	Rate of Alternation per Min.	No. of Alternations necessary to complete fracture.	Mean.
S 1	168	1330	1375
S 2	168	1456	
S 3	168	1352	
S 4	168	1361	
S 5	266	860	878
S 6	266	870	
S 7	266	916	
S 8	266	868	

TABLE I.

While the above results exhibit considerable concordance, those obtained from the fractured boiler plate were so erratic that for a time the author was almost in despair, when the curious clue to the situation presented itself, that one side of the plate was brittle and the other tough under alternating stresses. This theory is about to be put to a most careful experinental test, but in the meantime the data contained in Table 2 are, in all probability, substantially accurate.

The somewhat disconcerting lessons to be drawn from the above table are: (1) That once a steel has assumed decisive brittleness in alternation, it cannot be restored by heat treatment of any kind short of remelting; (2) that the injury to this steel was on one side of the plate, and hence due to unskillful reheating of the ingot and not an improper casting temperature, since the latter must necessarily have affected every portion of the plate. A third and still more regrettable confession has also to be made, namely, that

* Read before Section G of the British Association by John Oliver Arnold, Professor of Metallurgy, Sheffield University College.

the micro-structures of the pairs, including both brittle and tough steel, were in all respects identical, tho, of course, that of each pair varied with the heat treatment to which they had been subjected.

The author wishes finally to record some delicate and interesting tests obtained from an inch plate of mild steel bent over a radius considerably shorter than that of a large boiler, namely, about 2 feet. In such a plate the inside radius will represent a line of maximum compression stress, the outside radius a line of maximum tensile stress, and a radius exactly between the two will touch a neutral line. See Fig. 2.

If, from the apexes of two V's, *X Y*, progressing inward and outward, lines are drawn to the inner and outer circumfer-

Mark.	Rate of Alternation per Minute.	No. of Alternations Endured.	Heat Treatment.
L 3	169	420[1]	Heated to 950° Cent. and cooled in air.
L 4	"	1232[2]	
L 7	"	1378[2]	Oil quenched from 950° Cent.
L 8	"	694[1]	
L11	206	433[1]	As received.
L12	"	864[2]	
L18	"	260[1]	Heated to 950° Cent. and cooled in air.
L19	"	500[2]	
L20	"	388[1]	Annealed; heated to 950° Cent.; slowly cooled.
L21	"	781[2]	
L22	"	630[2]	Oil quenched from 950° Cent.
L23	"	240[1]	
L26	"	400[3]	Water quenched from 960° Cent. Heated to 600° Cent.
L27	"	336[3]	

Probable position of test piece: [1] Inside. [2] Outside. [3] Doubtful.

TABLE 2.

ences, these V figures will qualitatively represent the increasing intensity of the stresses at increasing distances from the neutral line. As to the quantitative value of these angles, the author has no practical data. Table 3 records the influence of stress in deteriorating the metal next the inner and outer radii, and also that immediately adjacent to the neutral line.

Mark and Position.	Rate of Alternation per Min.	No. of Alternations Endured.	Remarks.
O	266	916	Mean of ten tests
I	266	996	" "
M	266	1067	" "

TABLE 3.

It will be seen that in its resistance to fracture under alternating stresses, the portion of the plate in tension is inferior to that in compression, while the steel about the neutral line is superior to that next the inner radius.

All the results recorded in this paper are preliminary, having been carried out on an extemporized machine. A standard machine has now been erected at the Sheffield College, from which the author hopes to obtain, in the near future, standard data as to the influence of sizes and shapes of test pieces, length of stroke, rate of alternation, and the correlation, if any, between the data and the energy necessary to produce fracture.

Alcohol for Motors—II.

BY M. C. KRARUP.

Our principal sources of information in regard to the technical status of alcohol for motor use are the following:

The Centrale für Spiritus Verwertung in Berlin, an organization which is in supreme command of the alcohol movement in Germany, even to the regulation of the areas to be planted in potatoes or beets for alcohol production, has issued reports and other publications covering the German development for the past sixteen years.

Hon. Frank H. Mason, American Consul-General to Germany, deals in reports to the State Department of February 12, 1902, and February 16, 1903, with some portions of this material.

Report of tests by Prof. Dr. E. von Meyer, in Vol. 78 of the *Arbeiten der Deutschen Landwirtschafts-Gesellschaft. Rapports et Comptes Rendues,* from the Congrès des études économiques sur les applications de l'alcool dénaturé, 1903; especially the reports of E. Sorel, Gustave Chauveau and of L. Périssé.

Description of alcohol carburettors and sprays, by Prof. Schöttler in *Zeitschrift des Vereines Deutscher Ingenieure,* 1902, Vol. 46.

E. Sorel, "The Combustion of Alcohol in Stationary Motors," in *Revue de Mécanique,* May and June [not yet completed], 1904.

The *Journal of the Society of Arts,* London, April 29, 1904, has a paper by Thomas Tyrer, F. I. C., F. C. S., on "The Need of Duty-Free Spirit for Industrial Purposes," with tables giving very complete information on denaturizing methods and on chemical products in which ethyl or methyl alcohol enters.

The Engineer, of London, April 15, 1904; a paper by Dr. Ormandy, largely abstracted from information supplied by the German "Centrale."

Capt. C. C. Longridge discusses the results published by French investigators in articles in *The Engineer,* of London, of June 5, July 24, August 7 and August 28, 1903.

Report of the Joint Select Committee of Congress, appointed June 3, 1896, to consider all questions relating to the use of alcohol in the manufactures and arts. This relates only indirectly to the availability of alcohol for power-generation.

S. Young and E. C. Fortey: The properties of mixtures of the lower alcohols with benzine and with benzine and water, in *Journal of the Chemical Society,* Vol. 81 and 82, pp. 717-739 and 739-752.

A. Souchon, in *Revue d'économie politique,* Vol. 17, pp. 289-332. Paris, 1903. "L'Alcool et son Cartell en Allemagne." A study of the German organization of the alcohol industry.

G. Coupan, in *Le Génie Civil,* Vol. 41, pp. 117-123. Paris, 1902. "Concours et Exposition de Moteurs."

N. Wender: "Die Verwertung des Spiritus, etc.," Wien, 1904, and by the same author in *Zeitschrift des oesterreichischen Ingenieur und Architekten Vereins,* Vol. 56, pp. 229-232 *et al.*

T. E. Thorpe and J. Holmes, in *Journal of the Chemical Society,* Vol. 85, pp. 1-6, London, 1904. The estimation of methyl alcohol in presence of ethyl alcohol.

It is usually explained that the reason alcohol was taken up as a motor fuel so much later than the petroleum products was that scientists had condemned it untried on account of its low calorific value.

Alcohol has, indeed, much less heating capacity than an equal weight or volume of benzine, but it is, after all, not alcohol nor benzine that is burned in an internal-combustion motor. It is a mixture of alcohol vapor with air or a mixture of benzine (kerosene, gasoline) vapor with air. And the working efficiency of the motor depends more upon the calories contained in the explosive mixture than upon those in the liquid from which the mixture is only *in part* derived. It depends also, of course, upon the completeness of the combustion and some other factors. The relative caloric value of liquid alcohol, petroleum, etc., remains, however, a matter of economical importance, even if we find that a given volume (a cylinderful) of alcohol-vapor mixture contains as many heat units as the same volume of gasoline-vapor mixture. The figures pertaining hereto, and given below, will make this much clearer.

Two kinds of alcohol are under consideration; ethyl alcohol, or spirits of wine, in which the chemical radicals are C_2H_5HO, a potable inebriating liquid of 0.795 specific gravity, low cost of production, but taxed in this country $2.06 to $2.08 per gallon "commercially pure" (94 to 95 per cent.); the other, methylic alcohol, or wood spirits, chemical radicals CH_3HO, a poisonous liquid of slightly lower specific gravity with a cost of production probably twice as high as that of ethyl alcohol but free of tax in this country whether in its raw state or purified and deodorized, in which latter quality it is still poisonous (so claimed by adversaries, so shrewdly admitted by its makers, but the contention is perhaps doubtful) but well adapted to be used as an adulterant with or substitute for ethyl alcohol. For this reason Great Britain taxes purified wood alcohol equally with the ethyl alcohol, which is distilled from corn, grain, beets, potatoes, molasses and anything containing sugar or starch.

Wood alcohol has fewer heat units than grain alcohol and a more pungent odor, due mostly to the presence of methylic ether. As an independent motor fuel it has not been tested extensively, and the results so far have indicated less thermal efficiency (utilization of the calories) than obtained with grain alcohol, and a greater probability of free acetic acid in the exhaust, attacking the metal surfaces of the motor. Its eventual use for motor power

is not absolutely excluded, however, but would probably depend upon the invention of a cheap process for producing and purifying it. Its price at present in this country, under the protection of the tax on ethyl alcohol, with which it competes more or less openly for many of its uses, ranges from 70 cents to $1.50 per gallon, according to the degree of purification. In France its price is 110 francs per hectoliter, or about 45 cents per gallon (not 10.90 francs per hectoliter, as inadvertently stated in the *Engineering Magazine*, February, 1904, by Henri Dupays).

Raw wood alcohol is at present used for motor purposes only as an admixture to grain alcohol, mainly in France and Russia, serving the purpose of rendering it undrinkable and thereby protecting the internal revenue departments against fraud. Leaders of the alcohol movement in America propose to make the same use of it here, provided the tax on potable alcohol is so reduced that it will not pay to dissociate the mixture, danger of detection duly considered.

Grain alcohol mixed with methyl alcohol is variously known as methylated spirits, or alcohol denaturalized, denaturized or denaturated. Not knowing of any "naturalizing," "naturizing" or "naturating" process, I shall use the simpler form "denatured alcohol." The denatured alcohol prescribed in France for fuel purposes consists of 100 liters* 90-degree ethyl alcohol (10 per cent. water), 10 liters wood alcohol (also 90 degrees) and 500 grams heavy benzine (about ½ liter). At the price of 42.50 francs per hectoliter of 90-degree ethyl alcohol, this brings the price of denatured alcohol to 46.86 francs per 100 liters (including certain small fees), or about 38 cents per gallon. To reduce this excessive cost the French almost invariably mix this denatured alcohol with an equal volume of benzol. The benzol is obtained as a by-product from coking of coal and normally contains 85 per cent. benzine, 14 per cent. toluene and 1 per cent. xylenes. The results obtained with this mixture are, of course, not so conclusive as to the merits of alcohol as if alcohol alone, even if methylated, were used. The French public tests include many with simple denatured alcohol.

In Germany the denaturing agent for motor fuel is not wood alcohol, but 15 per cent. of benzol, to which is added a trifling amount of pyridin, and crystal or methyl violet dye in the proportion of 1 to 100,000. The alcohol is 90 volume per cent., holding 10 per cent. of water. This mixture is delivered by the Centrale für Spiritus Verwertung at any railway station in Germany at 15 marks per hectoliter in large lots and 16 and 17.50 marks in small quantities, packing included. This is equivalent to 15 to 17½ cents per gallon, and the *Centrale* guarantees that the price will not be raised before 1908, if then.

*In so far as the use of metric units in this paper is for purely comparative or percentage use, we have not thought it worth while to translate them.—Ed.

The law making denatured alcohol tax-free in Germany was passed in 1895; it attains this object by provisions permitting alcohol producers to concentrate the low general tax of the alcohol production on that portion thereof which is not denatured. Its operation to lower the price of denatured alcohol depends therefore upon the co-operative action of the distillers.

Those industries in Germany for which pure ethyl alcohol is a requisite pay a tax of about $1.00 per gallon (56 cents for whiskey strength), the same as for drinking purposes.

In many cases alcohol containing 25 volume per cent. of water—which is equal to 29.6 per cent. weight, owing to its higher specific gravity—has been used in stationary motors in Germany with satisfactory results, both with and without the denaturant. Without the benzol this 75 per cent. alcohol is of specific gravity 0.846, contains only 4,380 calories per kilogram, or 3,710 per liter, while kerosene contains 10,000 per kilogram and 8,000 per liter, benzine 10,000 per kilogram and 7,000 per liter, and benzol 9,700 per kilogram. Absolute ethyl alcohol, according to Prof. Dr. Mayer, contains 6,480 calories per kilogram, or 5,160 per liter.

In close accordance with these figures E. Sorel, whose chemical determinations always tally closely with those arrived at by way of mechanical tests by Maximilien Ringelmann, finds that 90-degree alcohol disengages 6,045 calories by combustion under constant pressure (as in a cylinder with the piston displaced by the expansion) and 6,056 when confined in a closed vessel; and that 90-degree methyl alcohol yields 4,594 calories per kilogram, either way. The usual French denatured 90-degree alcohol develops 5,923 calories, and when mixed with benzol, half and half, 7,878.

Figuring loosely upon the substitution of 15 per cent. of benzol for 15 per cent. of 90-degree ethyl alcohol, the German denatured mixture should contain about 6,413 calories per kilogram, or very nearly the same calorific value as absolute 100 per cent. ethyl alcohol, the benzol enriching it as much as the water impoverishes it. This coincidence adds peculiar interest to the high thermal efficiency obtained with the German denatured mixture, foreshadowing in a fashion the time when ethyl alcohol containing no other foreign ingredient except water may be used.

It may here be remarked that pure alcohol absorbs water from the atmosphere, when exposed, much more rapidly than it loses its own substance by evaporation. I find no data to determine at what degree of dilution the two actions offset one another, leaving the composition of the hydrated alcohol constant. It seems, however, that 85 per cent. alcohol and 15 per cent. water will evaporate approximately as a homogeneous liquid at ordinary degrees of humidity and temperature of the atmosphere. But some experiments on this subject would be desirable, since it should be known to what extent the composition of the fuel may be subject to changes from hour to hour when left in a tank with an air vent. Apparently pressure feed, bringing only a limited quantity of air or cooled exhaust gas in contact with the alcohol in the tank, will be preferable to gravity feed, even for stationary engines.

Some slight discrepancies in the above figures are probably due to variations in French and German terminology. It is not always clear, for example, if "90 degrees" and "90 volume per cent." (equal to 86.1 weight per cent.) are terms used strictly or approximately. Alcohol expands greatly by heat, but contracts by mixture with water, and this gives rise to variations when the strength is measured by volumetric instruments, instead of by weight. But these minor matters do not affect the conclusions, which are based on broader grounds.

The following table, extracted from more extensive determinations by E. Sorel (see *Revue de Mécanique*, June 30, 1904), is of the highest importance for perceiving why alcoholic fuel, in spite of its low heat capacity, will produce amounts of mechanical work in a motor larger than have been obtained with richer fuels in the same motor or a motor of the same cylinder volume or piston displacement.

	1 kilogram contains			1 kg. vapor occupies cubic meters.	1 kg. requires for complete combustion cubic meters of air.
	Carbon.	Hydrogen.	Oxygen.		
Wood alcohol (CH_3HO)	0.375	0.125	0.500	0.697	5.042
Ethyl alcohol (C_2H_5HO)	0.522	0.130	0.348	0.485	7.015
Benzine (C_6H_6)	0.923	0.077	none	0.286	8.273

Benzine is selected to represent kerosene and gasoline, being the liquid of most staple composition in this class.

We see here that a kilogram of benzine vapor, together with the air theoretically required to burn it, occupies 8.559 cubic meters, while the same weight of ethyl alcohol vapor mixed with air occupies only 7.500 cubic meters. In one case we have 10,000 calories in 8.559 cubic meters; in the other, 6,480 in 7.500 cubic meters. Equalizing the volume, the proportion between calories from benzine and calories from alcohol is no longer that of 10,000 to 6,480, but only 8,760 to 6,480; or, in other words, a cylinderful of combustible alcohol vapor mixture contains almost exactly three-fourths as many calories as the same cylinderful of benzine vapor mixture, which is a considerable gain from the proportion of calories in liquids as such.

With wood alcohol the proportion grows even much more favorably, giving 6,705 calories for benzine, corresponding to 5,104 (approximated) for wood alcohol; or, a

cylinderful of vapor mixture from methylic alcohol contains more than three-fourths as many calories as a cylinderful of benzine vapor mixture. And this seems to open certain possibilities for using wood alcohol alone, provided it is purified of the acetone which crops out in the exhaust as acetic acid and corrodes valves, and provided the price of the purified product may be brought within reach.

It is, of course, due to the oxygen (hydroxyl) contained in the alcohols that so much less air is required for its explosive combustion, making it possible to introduce relatively more vapor in each charge, but it should be remembered that this oxygen is paid for, while the oxygen used for burning benzine vapor is free for the taking. So far as anything yet said is concerned, the relative economy of the fuels is not affected, but the question of technical efficiency is of course deeply involved. Especially for use in automobiles it is of the highest importance that the lower calorific value of alcohol is offset by the ability to use more of it with a given motor. This also bears strongly upon the question of interchangeability of the fuels, in its favor. But for this factor it is more than doubtful if automobiles operated with carbureted alcohol in the French and international races could have held their own as they did.

Still, very little, if any, attention has been paid to this factor in favor of alcohol, perhaps because it is accompanied by others which make directly for fuel economy by causing the available heat units to be turned into work with much less waste than if gasoline were used.

The presence of oxygen and the excess of hydrogen in alcohol vapor, causing its smaller specific gravity (larger volume), and the greater kinetic velocity of its molecules by which its complete and intimate mixing with air is facilitated, have undoubtedly much to do with one of these factors, which consists in complete combustion (and odorless exhaust) of the explosive charge. No observation has been borne out more consistently at all tests since 1901 than that complete combustion is the rule when alcohol is the fuel and the exception with the liquids containing no oxygen.

The other factor leading to avoidance of waste or high thermic efficiency is the possibility of a very high compression in the alcohol motor, due partly to the low inflammability of the alcohol vapor, and furthermore to the aqueous vapors mixed with it from the water contained in the alcohol. High compression is, however, not only an advantage of the alcohol motor (in which the gasoline motor can never share unless of the Diesel engine type, for fear of premature ignition), but also a necessity, being required to counteract the slow inflammation which alcohol vapor has in common with kerosene vapor but not with benzine or gasoline vapor.

With regard to the causes for the complete combustion, L. Pèrissé and H. de la Valette are responsible for an experimental determination of great value. They find that the proportions in a 90-degree alcohol vapor mixture which admit of complete combustion in an explosion motor vary from 1 of vapor with 10 of air to 1 of vapor with 25 of air, while the proportions for 90-degree alcohol mixed with equal volume of benzol vary only from 1 of vapor with 41 of air to 1 of vapor with 52 of air.

The British Weights and Measures Association.

Particulars regarding the British association for the defense of existing British weights and measures, of which an item was published at page 1247, have come to hand, together with a pamphlet announcing the aims and purposes of the association. The correct name of the association is that given in the above title. The prime movers in the organization are manufacturers, and the following is a list of the Executive Committee:

A. H. Adams, director of the Sturtevant Engineering Company; H. A. Allport, member of the Institution of Civil Engineers, of the Institute of Mechanical Engineers and of the Iron and Steel Institute; Lincoln Chandler, managing director of the Patent Shaft and Alletree Company and of the Amalgamated Carriage Company; Archibald Denny, shipbuilder; Robert Kaye Gray, president of the Institute of Electrical Engineers; Henry Lovatt, builder; Walter M. Musgrave, of John Musgrave & Sons, engine builders; James Paxman, head of the engine-building firm Davey, Paxman & Co.; Thomas Parker, electrical engineer, who is now electrifying the London Underground Railway; Col. F. W. Tannet-Walker, of the hydraulic engineering firm Tannet-Walker & Co.

It is to be hoped that we may some day see electric welding done so commonly that it may be employed for uniting the ends of iron pipe when used for hand railing and similar purposes. The unsightly couplings on piping very much in the public eye are one of the things which modern engineering should be ashamed of and should be able to get rid of.

Letters From Practical Men.

Gas-Engine Cams.

Editor American Machinist:

The accurate laying off of cams always has been a more or less difficult problem to a good many people. The following is a method that I have used in laying off gas engine cams on the drawing board and I have found it to give good results.

For our problem let us take an exhaust cam. The exhaust valve is to begin to open, let us say, when the crank is 40 degrees above the forward center and to close when it is 10 degrees above the rear center, as shown in Fig. 1. Thus the valve is held open thru 230 degrees of the crank's revolution and therefore thru 115 degrees of the cam shaft's revolution. The cam proper is made up of two parts—one portion, *b m a*, Fig. 2, concentric, and another portion, *g e k*, eccentric to the shaft. For convenience we will consider the cam to be standing still and the cam roller to travel around the cam counterclockwise—*i. e.*, from *a* toward *b*.

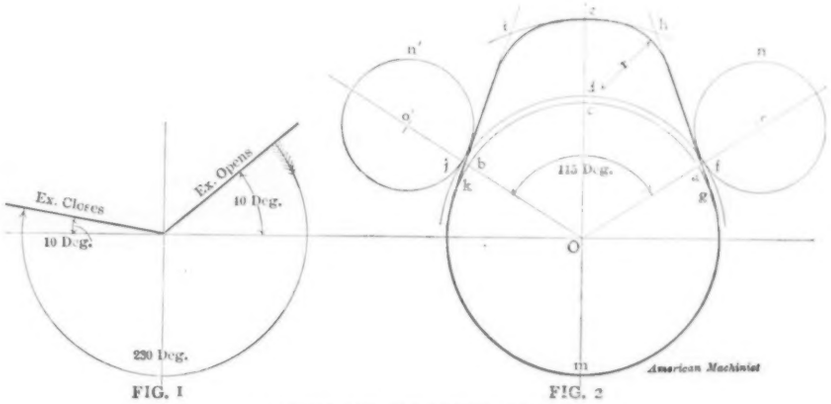


FIG. 1 FIG. 2

LAYING OUT GAS-ENGINE CAMS.

From center *O* lay off a circle *a b m* equal in diameter to the concentric portion of the cam. Then from *O* lay off *O a* and *O b* 115 degrees apart. *O a* is the line on which the valve begins to open, and *O b* the line on which it is just closed. Lay off *c d* equal to the amount allowed for lost motion before the valve begins to open and *d e* equal to the amount of the opening of the valve. With the center *O* draw arcs of circles thru *d* and *e*, respectively; *e* will be on the outer extremity of the cam. On *o a* and *o b*, produced, lay off circles *o' f n* and *o' j n'* equal in diameter to the cam roller and tangent to the arc *f d j*. Draw *g h* tangent to both circles *a b m* and *o f n*; similarly *k i* tangent to both *a b m* and *o' j n'*. This gives us the bounding lines of the eccentric portion *g e k* of the cam. The corners at *h* and *i* should be rounded off with radius *r*, to suit the judgment of the designer.

A similar method or reasoning applies to the inlet cam as well, altho the angle of opening is somewhat less than that of the exhaust cam. C. H. MARSHALL.

A Graduating Attachment for a Gear Cutter.

Editor American Machinist:

Recently we have started making a certain class of machine which has two fairly large parts that have to be graduated in degrees; the diameters of the indexed surfaces range from about 18 to 36 inches, so it will be seen that these would be rather large for an ordinary milling machine dividing head with its small worm-wheel, so we rigged up our automatic gear cutter for the work. This was done by mounting a compound rest on numerous wood blocks (a job which took about two hours) and turning the screw by hand to make each mark. This was a great improvement over the milling machine, as the gear cutter could be geared up to divide 360, so that after making each mark it was only necessary to pull a handle and the work was indexed for the next mark.

The compound-rest screw had four threads per inch, and in some of the larger work every tenth degree was about 3 inches long, every fifth degree 2¾ inches and the others 2½ inches, so that for the shortest marks it was necessary to turn the screw thru ten revolutions and for the longer lines eleven and twelve turns, respectively. The tediousness of the job can be imagined when it is considered that there are 360 lines to make, and every turn of the screw has to be counted to insure a uniform length of line.

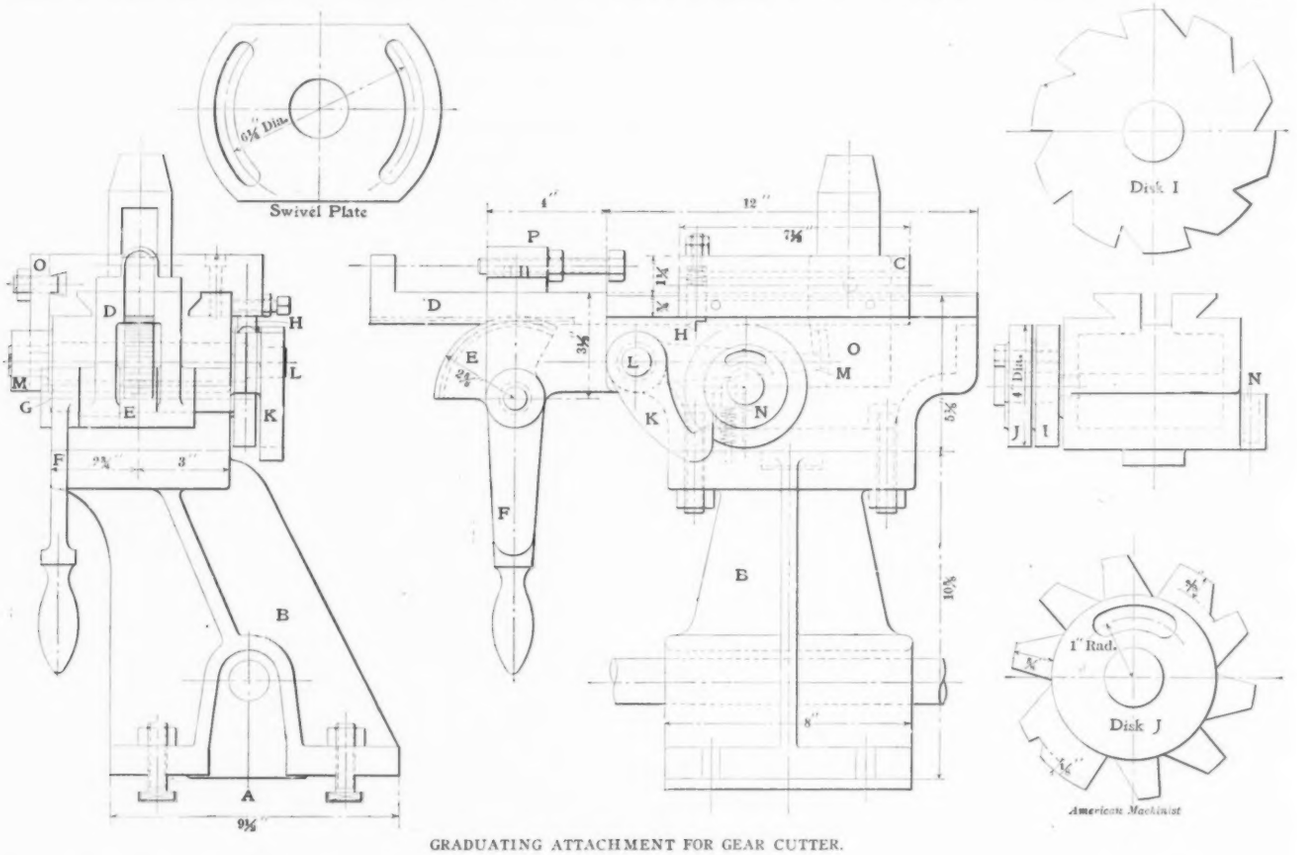
We decided to make an attachment which could be mounted quicker than the old arrangement, and which would be also quicker in its operation; the enclosed blueprint shows this attachment.

The bed of the machine is shown at *A*, a standard *B* being bolted to it; on this is fixed, with a swiveling adjustment, a compound rest with a slide *C*, which carries the tool; this slide is operated by the rack *D*, segment *E* and handle *F*, the handle being fastened to shaft *G* by a setscrew so that it may be set in different positions to clear other parts of the machine. One movement of the handle makes the cut—a great saving in time over having to turn a screw ten or a dozen revolutions. In the slide *C* is a spring plunger *H* that engages with a disk *I* which has ten notches cut in its perifery. To this is fastened by a small screw another disk *J* also having ten notches, two of which, however, are of different depths from the others; this is engaged by the finger *K* which is keyed to the shaft *L*, to which is keyed also the lever *M* which is pressed upward by the spring plunger *N* to engage with the steps on plate *O*. These steps correspond to the difference in length of the graduation lines, other plates being made for other graduations.

The operation of the attachment is as follows: The handle *F*, being pulled out, moves the slide *C* back (the return stroke of the cut), the plunger *H* engaging with the disk *I* turns it thru one-tenth of a rotation and with it the disk *J*, and *K* engages with one of the three different depths of notches in disk *J*, the shallowest representing every tenth degree mark and the deepest being for the units, because when *K* drops into a deep notch the lever *M* swings up to the top step of the plate *O*, the difference between the top and bottom steps being half an inch, which in this particular case is the difference in length between the ten marks and the unit marks. The stop *P* is for regulating the return stroke of the slide so that the hand may get used to a definite length of stroke and thus not use the lever *F* as a battering ram. The swiveling arrangement was necessary only to fit the attachment to our machine.

ALBERT CLEGG.

Keighley, England.



GRADUATING ATTACHMENT FOR GEAR CUTTER.

Dixie's Piston Rod?

Editor American Machinist:

There are two probable causes for the cutting of the intermediate pressure piston rods on the S. S. "Maple Branch," referred to at page 1238. The rods were not swabbed with oil in the days of excessive cylinder lubrication as they are now. Possibly the oil supply to the cylinders was diminished as the boilers became foul, and the rods received little, if any, lubrication. Consequently the packing heated, and the white metal wire, melting, adhered to the rods, and cutting resulted.

Possibly, too, the packing was leaking some time before "the man behind the wrench" overdid the job of cinching up the gland, as the packing certainly ran hot. If this theory would apply to the breaking of the connecting rod bolt on the S. S. "St. Louis," why not to the "Maple Branch" piston rod.

YANK.

Steady Rest Milling Fixtures

Editor American Machinist:

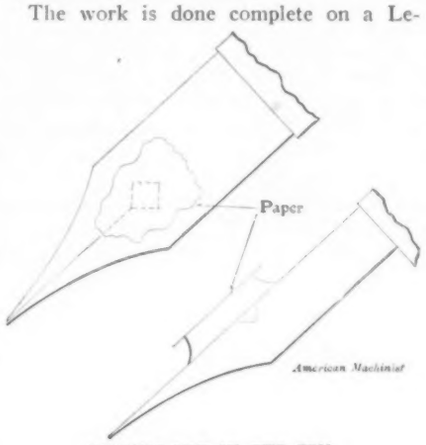
Fig. 1 shows a steady-rest, and Figs. 2, 3 and 4 fixtures for milling it. The first operation is that shown in Fig. 2, where the bottom of the rest is milled to fit the latheways, one side being flat and the other a V. The two pins *a* are permanently fixed in the base *b* and keep the rest from slipping back from the cutters. The two hardened pieces *c* locate the work so that the opening will be central with the V's of the lathe. These pieces are carefully set and then doweled in place. The straight clamp *d* and the three-legged clamp *e* serve to hold the piece securely. This fixture can be used for rests for 12- to 20-inch lathes by simply making a set of stops *c* for each size, as the T-slot *f* runs clear thru the fixture, as shown.

For the second operation the lower half of the rest is clamped on to a plate *g*, Fig. 3, and an end mill used which is wide enough to mill the part *h*, Fig. 1, and face the hinge *k*. The tops are milled in the same manner, only the vertical attachment is employed.

The top and bottom members are then put together and the slots for the jaws milled out radially. To do this the vertical milling attachment is used in connection with the rotary attachment, on to which the plate *l*, Fig. 4, is clamped by means of the bolts thru holes *m* which come directly over one of the T-slots in the rotary attachment. The hole *p* is bored to fit a plug pointed at one end and secured in the center of the rotary table. The angle-plate *r* fits on to *l* and is located by means of the shoulder *s* and the holes *t*. Sizes from 12 to 20 inch can be milled with this system by making a plate similar to *r* for each size. The dotted line *u* is an extension used on the larger plates to make up the distance between the angle-plate *r* and the shoulder *s*. The work on this fixture is held by means of a bolt passing thru the hole *v*, Fig. 1, and slot *v*, Fig. 4. The wings at one end of *l* and the holes therein are to further secure the work by means of a support and clamp, which hold the rest at *w*.

The work is done complete on a Le-Blond No. 3 miller, and the time consumed in milling the top and bottom and the three slots for the jaws, including putting on and taking off, is only 45 minutes. All cutters are made from Blue Chip steel.

JNO. A. CAMM.



KEEPING INK IN THE PEN.

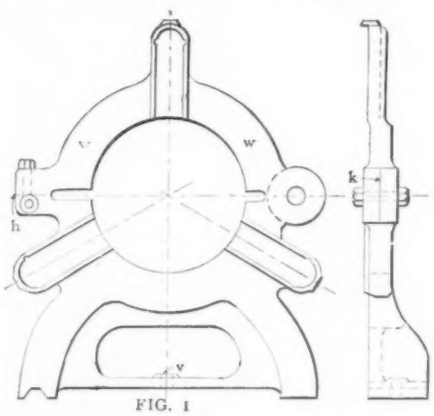


FIG. 1

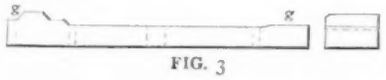


FIG. 3

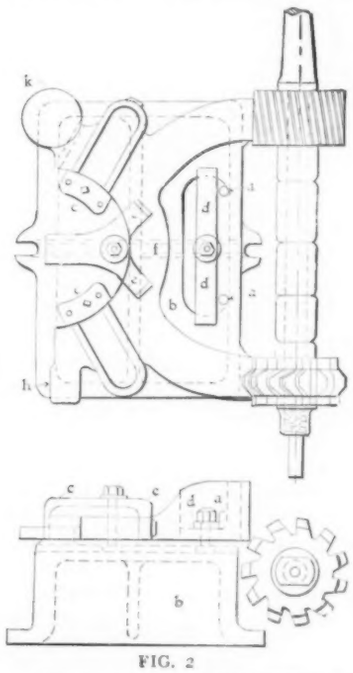


FIG. 2

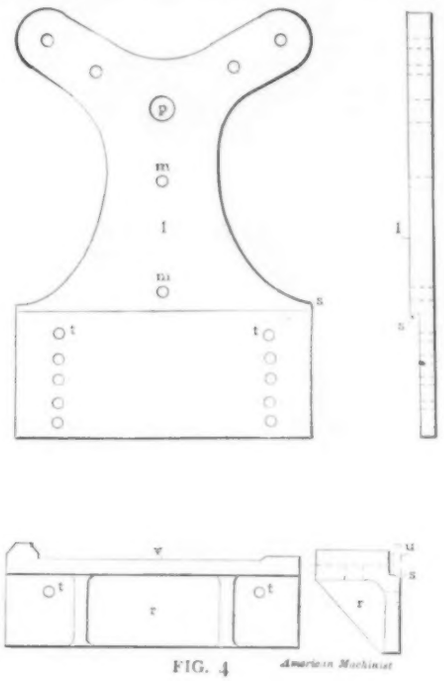


FIG. 4

American Machinist

STEADY-REST MILLING FIXTURES.

Lettering With the Pen.

Editor American Machinist:

Just a word or two about lettering. Anyone who has watched such work has noticed the great difference in appearance in letters, apart from their form. The principal thing about anything of that character is uniformity. Evenness of slope and hight and spacing are the most evident beauties. But we have all seen lettering that was nearly perfect in all these respects, that did not seem even and smooth. The eye is an exacting master and notes faults quickly. In this case the fault will often be found in the lines themselves. They are not even. They start light and end heavy or are thicker in the middle. This is partly the fault of the hand, but more often the fault of the pen—or, rather, the way the pen is filled. It is of the greatest importance, if one wishes to produce good lettering, to understand and study the action of drawing ink on the pen. One trouble is the pen makers do not understand the importance of the matter and have not made any great effort to fill this want. For india ink is very different in its action, both on pen and paper, from writing fluid. The principal point is its tendency to dry on the pen. The "round writing" pens have a little well just above the hole to hold the ink. And it might be well to take a look at a steel pen which operates by capillary action. We have a little hole thru the pen, which is slit below. To work well, the ink should be held by surface tension in the hole and fed down by it when pressure opens the nibs. And to produce the finest work all ink except a film should be so held. Everyone has noticed that the pen works best just before it dries up. This is because the superfluous ink on the nibs has dried and the pen has reached the ideal condition. Then we dip it in the well and put a lot of ink down near the point where we don't want it. In using "round writing" pens one does best work by filling the small depression above the hole from the "dipper" attached to the stopper. In this way the pen works evenly and our lines are even.

What we want, then, is to get more

storage of ink without danger of blotting; which brings us to the real point of this article.

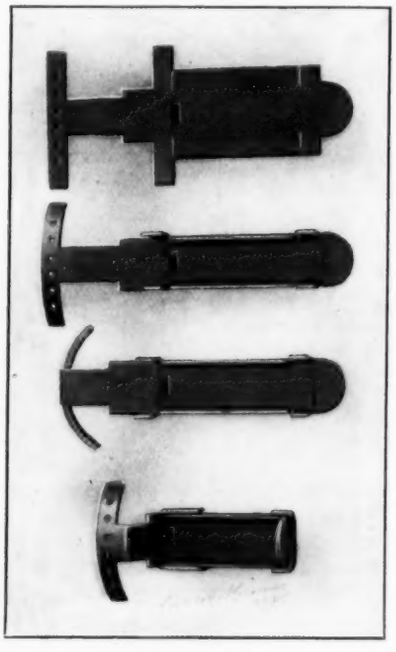
Take your pen—any pen you like—and fill it full of ink. That gives you a good supply. Then take a tiny piece of writing paper and lay it on the pen, just on top of the hole, as in the sketch. This helps matters all around. The bubble of ink formed under the paper makes an ideal storage reservoir and feeds regularly and evenly. Then the top of the ink is covered and evaporation is prevented. With such an arrangement one can lay the pen down and pick it up without cleaning and filling, provided it does not lie very long. All that is necessary is a few bits of paper; one fills the pen, drops a bit of paper on and fires away. When thru wipe the paper off along with superfluous ink. It might be well to add that this scheme, like many another good one, was "made in Germany," it coming to me from a native of that land. A DRAFTSMAN.

Blanking Die and Triple Operation Bender.

Editor American Machinist:

The accompanying sketches show the die and bender for manufacturing the piece shown in the successive operations in the photograph and also at the bottom of Fig. 3. The material used was sheet aluminum 0.025 inch thick, and it came to the punch in long strips 1¼ inches wide, the extreme width of the blank being 1 inch.

Fig. 1 shows the blanking and piercing



BLANK, BENDING OPERATIONS AND FINISHED ARTICLE.

die. The action of this die can be easily understood. At *a* will be seen the die for the small slot, 1/32x⅛ inch, in the middle of the blank. Owing to the size of this slot, it would have been difficult to get the same in the die block; therefore a hole 5/16x⅝ inch was cut out of the die block and a piece with a small slot milled into the side of it was fitted in.

The holes *b b* are for punching the guide or gage holes in the strip. At *e e* and *f f* the holes are for guide pins only, and no punching is done there.

At *c* is shown the "stop finger." The

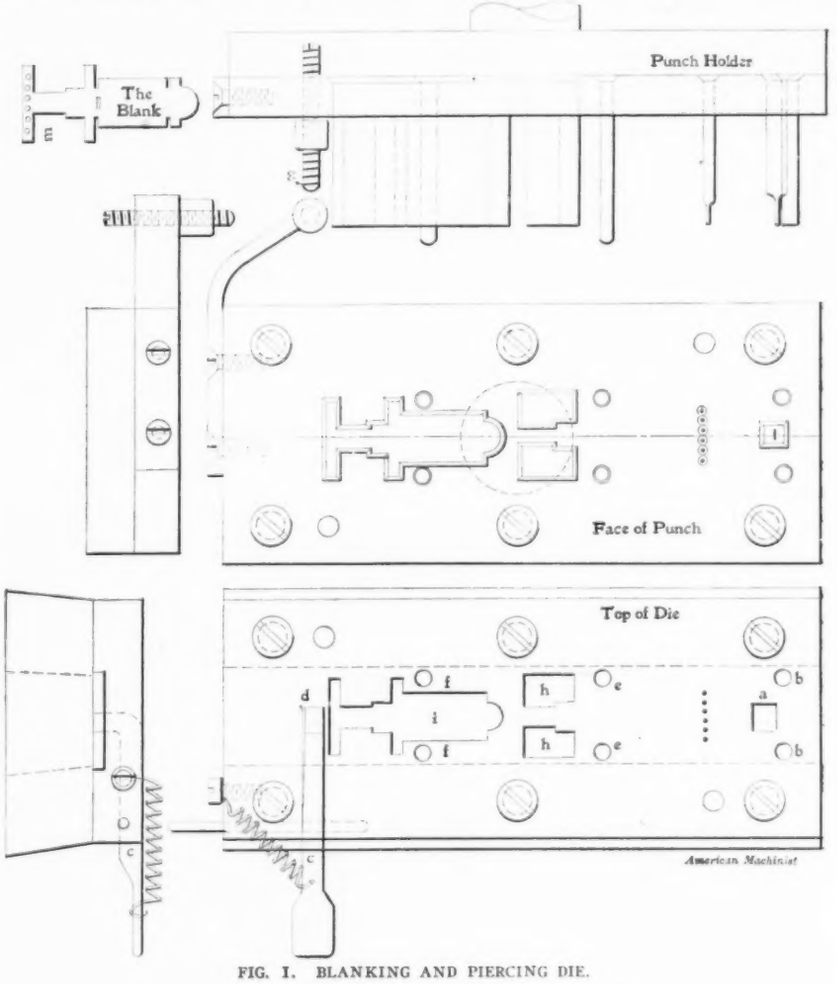


FIG. I. BLANKING AND PIERCING DIE.

slot is first cut into the stripper plate and then the finger is fitted into it. The finger is given plenty of side play at *d*, the satisfactory working of the finger depending on this. The action of the finger is like this. The strip, after the first and second punching operations, is pushed against the stop finger, forcing that end of it to the back or left side of the slot. The end of stud *g* on the punch-holder as the punches descend comes in contact with the outer end of the finger, causing the inner end to be raised clear of the strip. Then when the punches ascend the finger returns, but instead of dropping into the position previously occupied it will, on account of the side pull of the spring, rest on top of the strip—by a very small margin, 'tis true, but sufficient to hold it, and it will again drop as the strip is pushed thru, and when the end of the space just punched is reached the finger will again act as a stop.

The six small holes in a row shown in the die are 1-32 inch diameter. The punches for these are all upset at the back or upper end to prevent their pulling out.

The little rectangular hole and the row of 1-32 inch round holes are the beginning of the punching of the blank. When the strip is pushed along to its next position the pieces *h* are punched out from the sides of the blank and on the third stroke the finished blank is punched out, and thereafter a blank is dropped at each stroke. The four narrow slits in the sides of the blank, being only 1-64 inch, were thought to require a punch too thin for safety and accordingly these slits were sawed, the blanks being placed in solid rows so that they were cut very rapidly.

Figs. 2 and 3 show the bending or forming die and at the bottom of Fig. 3 are the successive results of the three operations. As this die is of a familiar type which has been fully exhibited in the columns of the AMERICAN MACHINIST, it is thought that no explanation is necessary.

WM. F. HOFFMAN.

Machinery as Real Estate.

Editor American Machinist:

At page 1246, under the above caption, appeared an article which recalled to my mind an article which I read in one of the daily papers recently. Whether it be good law or not, I leave to those better versed in Blackstone than I.

A boy had entered a house and stolen some lead pipe. A young lawyer was

selected by the judge to defend. He argued that as the lead pipe was fastened to the house, it was real estate, and consequently could not be stolen. A verdict was returned in favor of the defendant.

DIXIE.

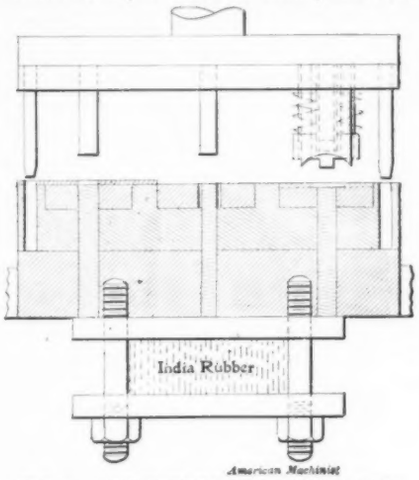


FIG. 2. TRIPLE OPERATION BENDING DIE.

The Reamer.

Editor American Machinist:

My definition of the above word would be an expensive and unsatisfactory small tool found in every machine shop in all stages of decrepitude.

It consists of a serrated or fluted cylinder the cutting edges of which are hardened. Its use is to make the machinists and the boss feel that a lot of holes will be made true and all alike by it. Generally, however, only one of the holes will be alike and it is not apt to be true.

Two varieties of reamers are found and, as a rule, the man who buys either wishes he had bought the other kind. One is made of a single piece of tool steel and is called a "solid reamer." The other is made up of a body in which are fitted tool-steel blades more or less solidly, generally less. These are called "adjustable" or "inserted blade reamers."

The careful, thoughtful machinist makes a reamer a "leetle" over size in some parts of the world; in England it is made "just a bit over size"; in Scotland, a "wee bit full"; here it is sometimes a "dream" or a "mite" large, or at times .002 over size, according to the locality and shop.

The reason for so doing seems to be that as no man can make a reamer which will ream a given size of hole and keep on doing it, it is best to start wrong anyway, hoping that at some stage of the reamer's life it will wear enough to give what is wanted.

The inserted blade reamer is a great source of thought for the inventor, and gives rise to hopes in the heart of the proprietor until he buys some; then he likes the other kind better.

Reamers are abused as follows: The piece to be reamed is clamped in a vise; a wrench, which does not fit the square on the reamer, is obtained and the machinist turns it until the wrench hits the bench. The reamer is now standing anywhere from 5 to 45 degrees from its proper alinement; the wrench is drawn off and a new hold is taken. The foreman sometimes comes along at this stage and tells the machinist to put the piece in the vise so he can ream it vertically, and shows him how, and the reamer drops thru the hole.

If a reamer makes too small a hole, waste is introduced into the flutes, on a wire, to jam it over and thus make the holes large enough to let the shafts go thru; this takes no end of time, but allows the machinist and proprietor to truthfully say that all the holes in that job were reamed, which gives them a feeling of virtuous mechanical uprightness, and they believe they are giving a first-class job.

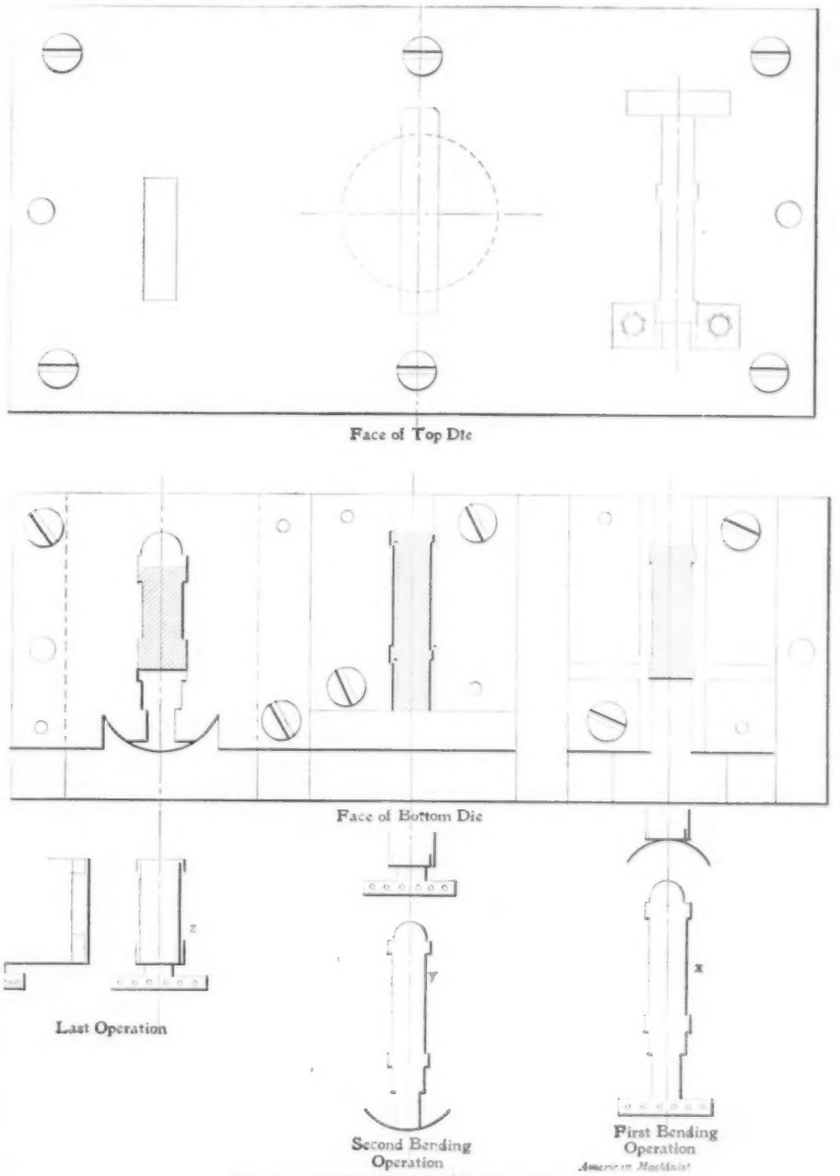


FIG. 3. TRIPLE OPERATION BENDING DIE.

Inserted blade reamers of some makes allow a man to take them apart and put them together again, so that they will not ream at all at first, but the blades can be packed out with paper until they cut large, and then it is an easy matter to make new shafts to fit the holes and to re-ream the other holes for the shafts at the expense of the boss or the man who is paying for the job. A note can be made that the holes in those machines are enlarged, and the note is pretty sure to be lost.

This style of reamer has the advantage that it is some trouble to pack out the blades, so it is not often done.

Another kind of expanding reamer is not open to this objection; in fact, several other kinds can be easily made worse than they were by simply driving in the taper blades or bulging out the sides by means of a taper-pointed screw; if the taper-bladed kind don't twist out of shape or the screw-bulging kind don't crack, very unsatisfactory holes can be obtained of all sizes by their use.

Faith in reamers making known sizes of holes has cost the engineering world a lot of money. The following advice is given concerning them: For holes below one inch, the solid kind will be found more satisfactory; above one inch, the

inserted style will be better if you get the right kind.

If holes are what is known as "thru holes" and are in pieces which admit of being chucked in a lathe or held on a boring-mill table, round, true holes all of a size can be made by means of a cutter bar, provided both ends of the bar are firmly supported and the cutters are properly made. W. D. FORBES.

A Special Milling Job.

Editor American Machinist:

The sketches will suffice to show a small steel piece which was to be manufactured in fairly large quantities and the tools for making it. The latter may be of interest as showing what small outlay was required for the particular operations here shown. Fig. 1 is a shop card showing the successive operations. The finish dimensions at *G* were required to be accurate. The material used was ¾-inch-square mild steel, and the first operation, *A*, was cutting off the pieces. This was done by a small power saw, operations *B*, *D* and *F* on a small horizontal bench miller with hand feed, and operations *E* and *G* on a universal miller with a vertical spindle attachment, as we had no suitable vertical machine. The same vise, Fig. 2, was used for all the milling operations, the gripping jaws being changed as required. The moving member *H* has a horizontal round stem which runs thru to the front where it is drawn up by a nut, the spring forcing it back when the nut is unscrewed.

At *B* a groove was milled in one side of the piece, at *C* the opposite side was roughed out to the required semicircular shape, and at *D* this outline was finished. At *E* the dovetail groove was roughed out, at *F* the piece was finished to the exact length, and at *G* the groove was finished. For this operation the table had a slight cross adjustment controlled by stops and the groove was milled down one side and up the other. For operation *F* a swinging stop was used to locate the position of the work in the vise. Fig. 3 is the cutter for operations *E* and *G*, while for *C* and *D* backed off cutters were used. Fig. 4 shows the mode of chucking. Attention is particularly called to the gripping for the dovetailing operations. It holds the work firmly up against the lip of the vise and insures uniformity of depth for the grooves. McANICK.

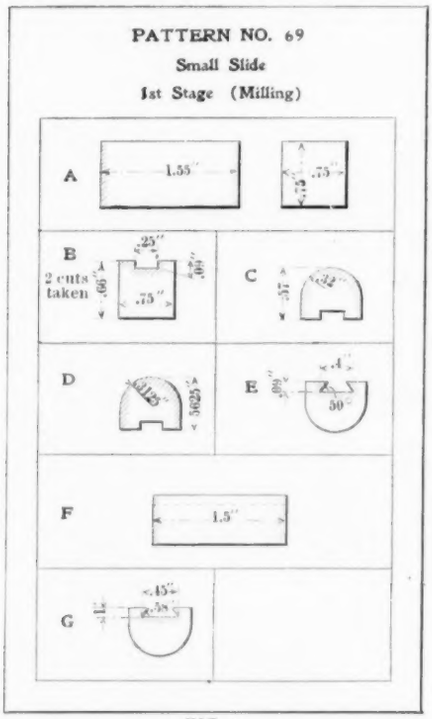


FIG. 1

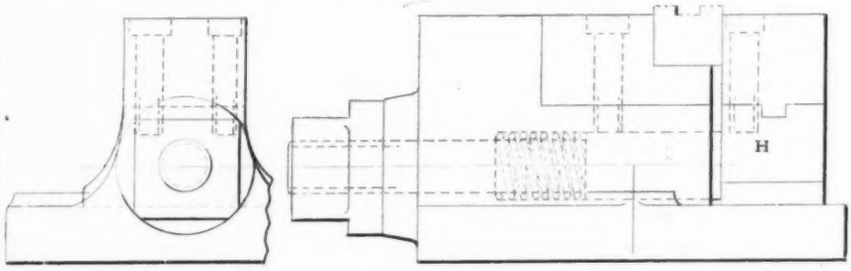


FIG. 2

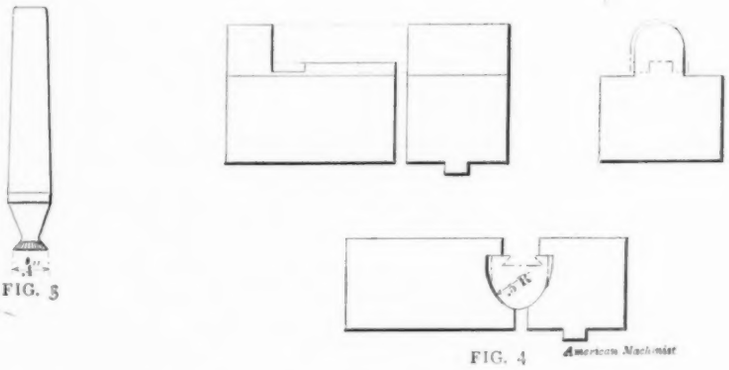


FIG. 3

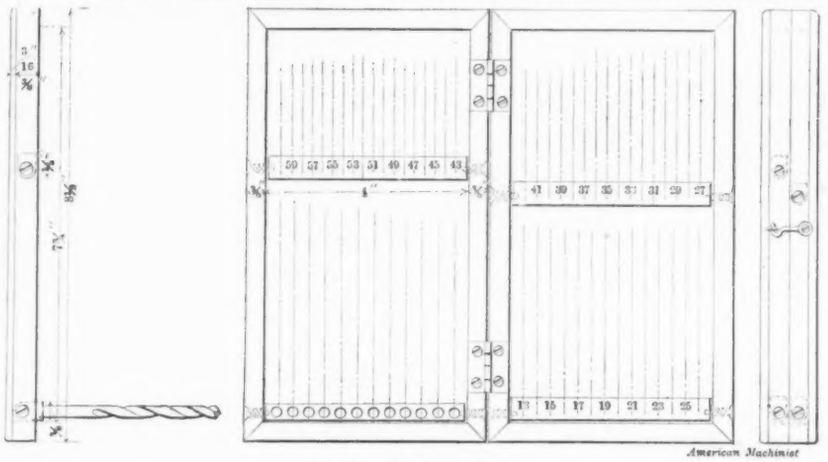
FIG. 4

OPERATION CARD AND TOOLS FOR A SPECIAL MILLING JOB.

A Handy Twist Drill Box.

Editor American Machinist:

As I have seen in the AMERICAN MACHINIST several devices for keeping twist drills, allow me to send you one that I made some years ago for putting away in my tool box when not in use. The middle view shows the box open. It contains four drill holders with the numbers of the drills stamped thereon; they swing on pivots screwed thru the frame of the box. The left-hand view shows one drill holder lifted up with a No. 1 drill in position to be taken out when wanted. The positions of the other drills are indicated by the center lines. At the right is shown a side view of box when closed. I have found it very handy. O. F. PAUL SPITZEL.



A HANDY DRILL BOX.

Large Prime Number Indexing.

Editor American Machinist:

The expedient shown by H. T. G. at page 1243 reminds me of a similar job that I saw a long time ago. An index plate with eighty-seven holes was wanted for a Brown & Sharpe miller; so a brass index plate was made, and a sheet brass strip about 1-16 inch thick was bent into

a circle, which was sweated on to the edge of the plate. After indexing this ring with eighty-eight "V" notches, it was "soldered off," one interval was cut out, the plate was turned down the proper amount and the ring was soldered on again. It then had eighty-seven "V" notches in its edge, which were used as an index to drill the required eighty-seven holes. That job was done by John Geary, in the Western Union shop, some time in the seventies, long before compound indexing had been threshed out; but perhaps H. T. G.'s excuse for doing the job that way in modern times is that his gear cutter could not be worked on the differential principle.

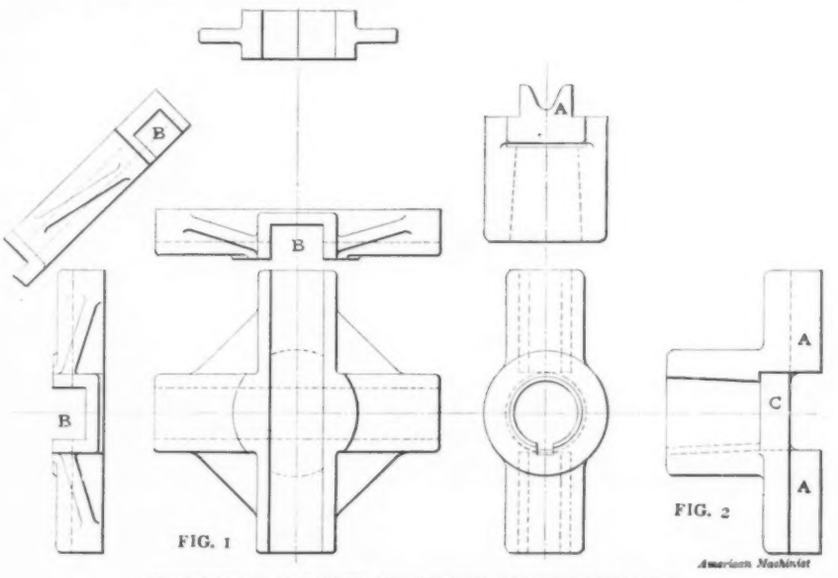
WALTER GRIBBEN.

Coupling for Parallel Shafts Not in the Same Line.

Editor American Machinist:

Having had occasion recently to use a coupling for parallel shafts whose center lines do not exactly coincide, and failing to find in Reuleaux or other reference books a design which suited me, I evolved the design shown herewith.

The principle is familiar—a casting 2 is put on the end of each shaft, both interlocking with the middle casting 1. As the whole revolves, the middle casting moves sidewise and vertically, the projection *A* on the shaft castings working freely in its grooves *B*, thus transmitting the motion of the driving shaft to the driven shaft



COUPLING FOR PARALLEL SHAFTS NOT IN THE SAME LINE.

without shock or bending stresses, even tho the two shafts be inches out of line.

Castings 1 and 2 are designed for lightness, while lightness has to be sacrificed to some extent in making the external edges circular, to avoid injury to workmen by catching their clothing. All are of cast steel.

Recess *C* is provided to receive a nut by which the casting is secured to the tapered end of the shaft. For ordinary shafts with plain ends, these recesses would not be used, and the length of hub could be correspondingly reduced. R. S. R.

Some Piston and Piston Ring Tools.

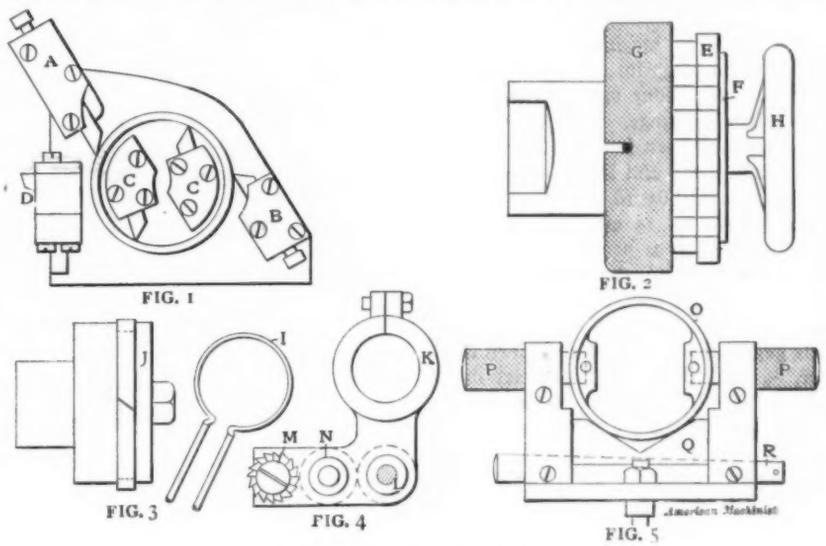
Editor American Machinist:

As pistons and piston rings are closely related, and the article at page 928 was of great interest to me, and no doubt to many others, the following is submitted in the hope that it also may prove of interest.

Defective piston rings are also the cause of a great share of gas-engine troubles, as on them depends to a great extent the power and efficiency of the gas engine, especially if high compression is employed.

In view of this fact the fixtures shown were designed by the Olds Motor Works to produce as nearly as possible a uniform and accurate product. The fixtures have been used for the past year and have turned out rings for something like 2,000 pistons, yet show no appreciable wear or inaccuracy. In the manufacture of the rings the conventional ring casting is used and bolted to the face-plate, the roughing out being done by the rig shown in Fig. 1, in which *A* and *B* are the roughing and finishing tools respectively; the boring tools are shown at *C*.

After the boring and turning operations have been completed the rig is brought back for engagement of the gang tools *D*, which are used in the same manner as the ordinary cut-off tool. The ring is then placed on the expanding arbor shown in Fig. 2, in which *E* is a split ring expanded by the slightly tapering cone *F*. The nurled sleeve *G* affords an easy and rapid



PISTON AND PISTON RING TOOLS.

means of setting the ring true on the arbor, it being slid into contact with the face of the ring.

After the ring is gripped in place by turning hand-wheel *H*, the sleeve *G* is pulled back, leaving both faces to be operated on by the double facing tool. These sides are now ready for grinding. Contrary to usual practise the ring is first slit and then turned eccentric. The advantage of this lies in the fact that a ring so made assumes a truer circle when in its place in the cylinder. After leaving the grinder, the necessary stock is removed in the slitting operation and the ring is then ready for the eccentric chuck shown in Fig. 3. When in place the ring is sprung together with the left hand by means of the clamp *I*, and the plate *J* drawn up by the right. The ring is then finished with a gang tool, which concludes the operations.

Perhaps Mr. Garland would like to know how we do that piston-pin-boss facing job. The rig we use is very simple and may be of interest to others. Fig. 4 shows an end view. The sleeve *K* is clamped to the arm of the milling machine and the gear *L*, driven by the spindle, drives the cutter *M* thru the gear *N*. As the gears lie between two arms and the mills are on the outside, there is no tendency to clog.

The fixture for holding the piston during this operation is shown in Fig. 5,

which shows the piston *O* held by the plugs *P* passing into the pin holes, the piston being alined by the sliding V-block *Q*, raised by the wedge *R*.

The piston after milling, and with the pin locked in place, goes to the grinder. The pin mentioned is of the expanding type, and is expanded before the piston goes to the grinder, in order to secure as nearly as possible the conditions obtaining when the piston is in the cylinder.

H. FREY.

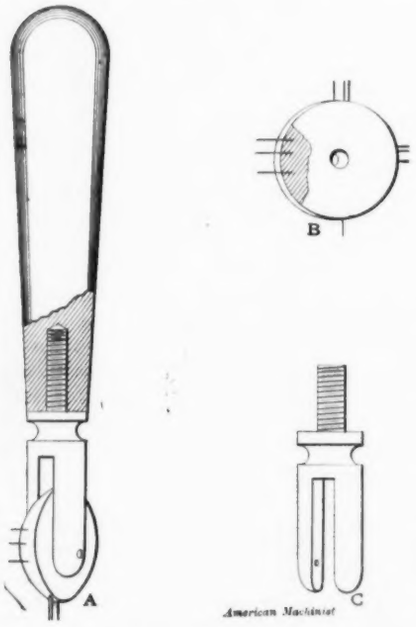
A Lettering Gage.

Editor American Machinist:

I enclose a blueprint of one of the most useful articles about my drawing table—*i. e.*, a lettering gage. I made one about a year ago and soon found it indispensable. It is easily made and any draftsman who has much detailing to do should not be without one. It is especially useful in detailing when it is necessary to give the name, the material, the number required and the scale for each detail.

At *A* in the sketch is shown the complete gage. *B* is a brass disk ¾ inch diameter, ⅛ inch thick, with pins set in for different size letters—3-32, ⅛ and ¼—and fitted also with a single point. *C* is a piece of 5-16 inch brass rod turned, threaded and slotted to fit tightly over the disk *B*, which is held in place only by the pin which is its axle. By simply turning the disk with the fingers one can get points for the desired size of letters.

It not only is a great time saver, but enables a draftsman without any trouble



A LETTERING GAGE.

to get all his letters on different parts of a drawing exactly the same size, whereas if the spaces are measured off, there will probably be some deviation in size which, even tho slight, injures the appearance of a drawing.

FRED S. CRISPIN.

Grinding High-Speed Cutters.

Editor American Machinist:

In sharpening milling cutters of Novo steel on a dry emery wheel, I found that by having the cutting surface of the wheel less than one-thirty-second of an inch in width, it cut longer and better than a wider wheel. This was new to me, but perhaps others have noticed it before me.

OWEN.

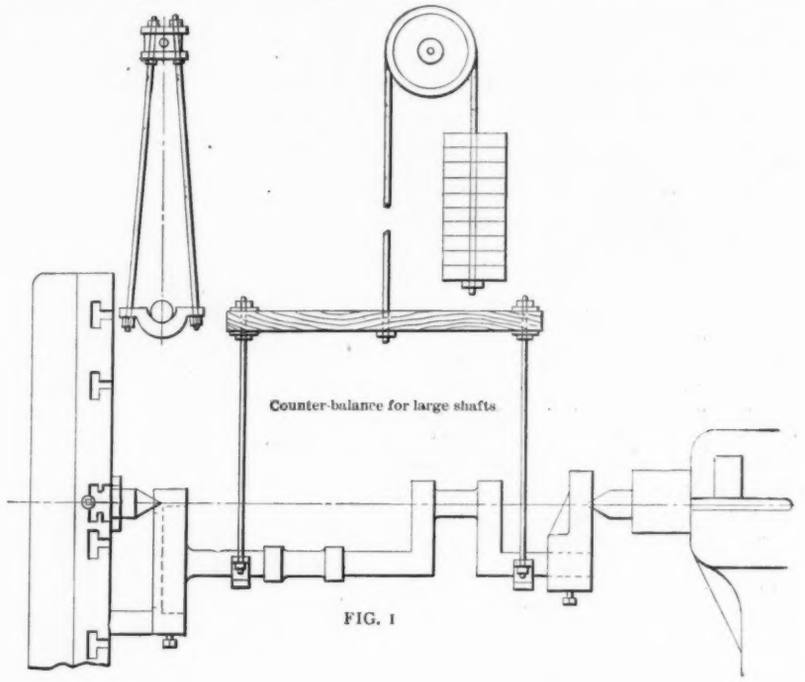


FIG. 1

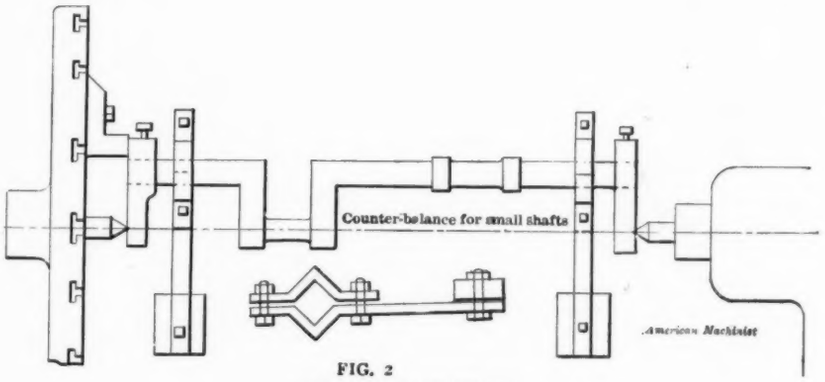


FIG. 2
TURNING CRANKSHAFTS.

The Universal Drafting Machine and Drawing Pins.

Editor American Machinist:

Writing at page 1139 about the drafting machine, Mr. Shaw reminded me of a few experiences I have had with mine. My scales ran up against the drawing pins and came off the worse—minus little bits of the edge—so I sunk the pins below the face of the board by slicing the corners of the board off parallel with the surface, and then smiled; but after a while the corners got so "holed" that the pins could not be coaxed to stick in the wood. Then the genius of our pattern shop stepped in and brought along with him the best thing in the way of pins I've ever seen. There are three parts to this pin—all brass: a 3-16x ⅜-inch screw with head ¾ inch diameter and 3-64 inch thick; a ¾x3-64 inch washer, and a ⅜ inch diameter by ½ inch long barrel to drive into the board at each corner to receive the screw. The latter is not pushed thru, but grips the edges of the paper between the head and the washer, and it grips it like a Briton—why, one can tear the paper before it will let go. I ought to explain that we never use any but the full-size sheet of paper, so that the pins may be fixtures in the board.

I once had my machine work very stiffly in one of the joints. There was no way out but to take the arms off to discover the offender. Having done this, I cleaned and oiled the pin and started again. It was evident I had been working too hard and galled the bearing—but the governor probably wouldn't have said so.

W——, England. E. LEWIS.

Turning Crankshafts.

Editor American Machinist:

In most shops crank-pins are turned by counterbalancing them with weights put on the opposite side of the faceplate, which is a mistake. If you go over them with a micrometer it will be found that

they are out of round from .001 to .005 inch. The reason for this is because the work is balanced on one end only, the other falling behind on the downward part of the revolution and dropping ahead on the upward turn, causing the shaft to work sideways; whereas the proper way is to counterbalance evenly on both ends, as shown in Figs. 1 and 2.

If you will turn the pins as in these two sketches, and the body of the shaft as in Figs. 3 and 4, you will find they will be very accurate and that they will not be apt to run hot unless overworked.

It is a very difficult thing to turn a crank-shaft when the pins are on a quarter and get it to run perfectly true. An opposite crank, or a triple crank, will run

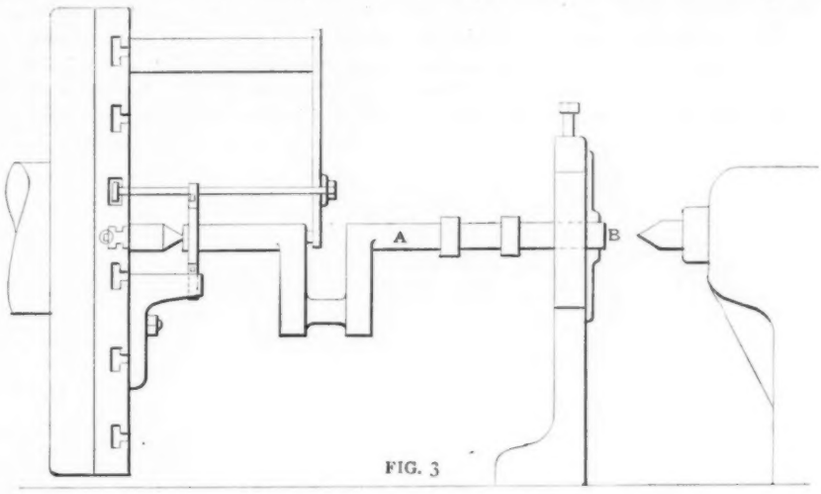


FIG. 3

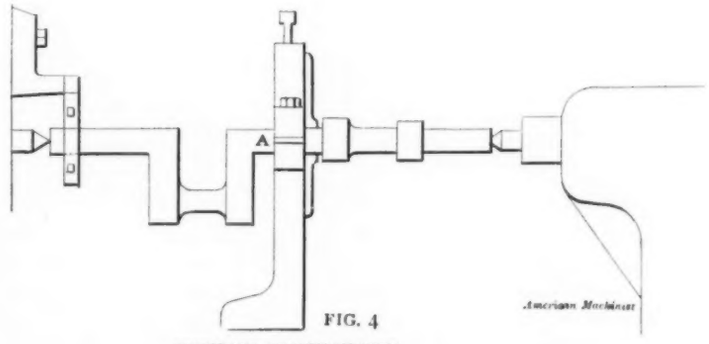


FIG. 4

TURNING CRANKSHAFTS.

true when you put the center against the ends, but a quarter crank will push a little toward one side, as the third pin is missing. Of course you can put a piece between the webs, but even then it will not run perfectly true. The best way then is to set it as in Fig. 3 and turn the portion *A*, which is between the pins, first; then put your steady-rest at *A*, as in Fig. 4, and turn the rest, but be sure and do not let the center touch the shaft at *B* until you get *A* completed.

MORTIMER PARKER.

The Drag of Habit and Prejudice.

Editor American Machinist:

It is very amusing to notice the influence of human prejudice in regard to machine design. I worked with an old fellow who used to claim that only things which looked right were right. He had developed his judgment by experience until he could tell by inspection whether a thing was correct or not—sometimes. No one denies that it is possible by trying devices for years to so develop one's guessing powers as to make them valuable; but this very thing alone is responsible for a lot of the poor design that is abroad to-day. A fellow says a thing is all right because he remembers similar things that were right, or he endorses a thing on the strength of its likeness to other things which work all right. This tends to keep things in a rut. It is easier to design a machine from an accepted style than to strike out along new lines, and 90 per cent. of the engineering done in the world to-day is done in that way: taking a machine that is O. K. and changing it a little.

I remember some years ago running across a strange case of degeneration in a line of machines due to this very rule-of-thumb designing. One of the first lines of electric motors successfully brought out in this country were the Sprague machines. If anyone is curious enough he can find them fully described in Thompson's "Dynamo Electric Machinery," with dimensions, etc. A little one-horse concern started to manufacture these machines, and at the time I am speaking of had been building them for about three years. They had no designer, properly so called, their manager doing whatever calculation was done, and the only criterion they had was the speed of the machine. If it did not come right, they put on more wire on either armature or field, as the case called for. Now, for some reason the tendency generally was to put more wire on the armature and less on the field, and principally because wire could be changed on the field easier than on the armature. The change was small in any one machine, but gradually conditions got worse and worse until the concern finally produced a small generator that would give 10 horse-power and no more under any conditions. With its proper external resistance it gave 10 horse-power, and as this resistance was cut down, calling for more current, the machine refused to give any great increase because there was so much wire on the armature that it overpowered the weak field. The machines had been designed by rule of thumb until they had run to the limit.

And it is so with many things; but machine-tool builders have in the last five years cut loose from many firmly established precedents. Some will claim that the more recent changes are due to the demands of high-speed steels, but this is not wholly true as they mean it. The new steels have indeed caused investigation and investigation has caused change; but many things have been altered lately which should have been changed for other reasons years ago.

Men make up their minds that a thing is so and maybe cling to a mistaken notion for years because it does not happen to be disproved. It's like Casey, McTodd and the searchlight. Casey was a little red-headed Irishman who did construction work, and McTodd was the engineer on the "Keystone State." McTodd had one of the original searchlights—the one that Adam picked up Mt. Ararat with, maybe. Anyway, it was very old and very poor; so, as the line waxed prosperous, Mac decided he would have a new light, and he accordingly ordered one. It came, and Casey put it up on the pilot house and wired it up. But when they tried it, altho in Casey's eyes it was very satisfactory, Mac scorned it. He said it was not as strong as his old one because the glass in the front was not cut. In his old light —a cast-iron affair—the arc was about 8 inches from the glass in front, and, to prevent the unequal expansion breaking the glass, it was cut into slips perhaps 2 inches wide. It was nothing but ordinary window glass and its only function was to keep the draft from the arc. In the new light with a long barrel the arc was so far away that the glass was made all in one piece. So when Mac had remonstrated with Casey about the "uncut" glass he had been put off "until it was tried." Of course it was not to be expected it would be satisfactory under those conditions. Mac would not have it. He had a bit of the mule in his make-up and he stuck to his decision, which was "cut glass

or none." Casey also was somewhat stubborn, and altho he brought the front door and glass back to the shop he did not fancy giving in; and so he put his head to work and evolved a scheme. He put the glass on the bench and then he took a piece of Ivory soap and whittled it to a thin edge and taking a straight-edge he made narrow lines across the face of the glass to represent cuts. That evening he sneaked it on the boat, and when Mac from below saw the glass cut as he had directed he became most affable, and when the light was turned down the bay he declared it increased its power 100 per cent. to be properly cut like that. But when the quartermaster cleaned the glass next day at sea and made his report, they say he was treated to "hot Scotch."

F. W. HARRIS.

A Reamer Experience and Some Modern Lathe Work.

Editor American Machinist:

An interesting bit of reamer experience has recently provoked considerable discussion in a certain Western machine tool shop, in which an attempt is being made to develop and specialize every operation to its highest capacity, with the intention of placing the entire shop on a "slide-rule" basis. The question of what we can and what we cannot do with our modern tools and high-speed steels is a potent and vital one to every manufacturer, the ultimate solution of which will require more data than we now have available for its answer. Every experience of this sort, then, is a brick added to the foundation upon which we are to build.

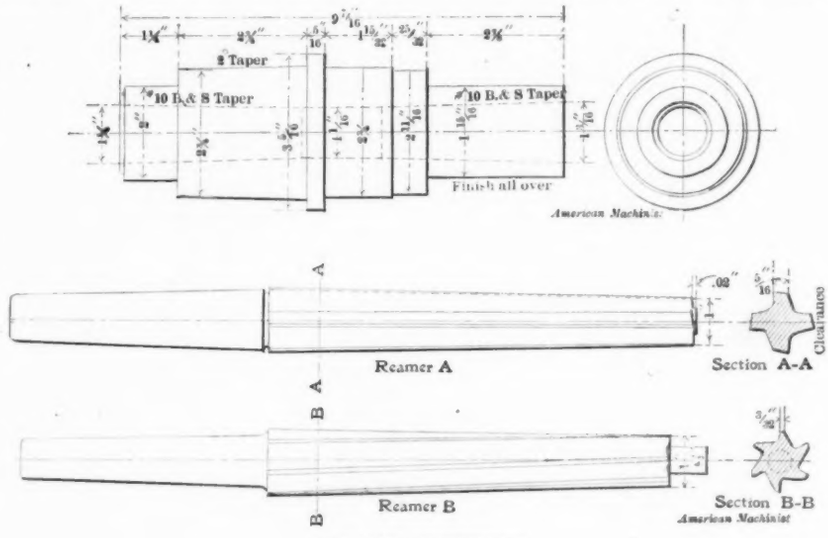
A lot of crucible-steel spindles, of 50 point carbon, were to be reamed with a No. 10 Brown & Sharpe taper reamer at each end of the spindle. The stock, 3⅜ inches diameter by 9½ inches long, was rough drilled with a ⅞-inch hole its entire length, and the stock roughed off to 1-16 inch of finish size on a rapid-reduction lathe, using two cutting tools and special centers for holding the work. After roughing, one end was turned true for a steady-rest bearing, and then the reamers were brought into play. Being in something of a hurry for the work, the spindles were divided between two machines for reaming, and were to have one end reamed to finish size and finished by a hand reamer. The other end was to be rough reamed, to be later bored dead true with the first hole. Both machines were amply stiff and strong, and each was carefully adjusted for wear and play. A sketch of the two reamers used, and also of the finished spindle, is shown. Both reamers are of the same quality of "Bohler Rapid" steel, but, as will be seen, reamer A is a heavy, straight fluted, four-tooth, square-ended reamer, while *B* is a lighter, left-hand spiral fluted, six-tooth reamer with a ½x¾-inch tit on the end. Both are of the "hog-nose" type—*i. e.*, are ground to cut on the ends of the teeth as well as on the edges. The rough-drilled hole in the spindle was made small (⅞ inch), so the reamers would cut their way through independently of it.

So far so good; but here the trouble began. Reamer *A* was run at 312 revolutions per minute (the work revolving in both cases) with a lead of .0056 inch per revolution, giving a maximum cutting speed of 102 feet per minute and a travel of 1.75 inches per minute. The time for reaming each finished hole was 3 minutes 32 seconds, or including setting, removing and all handling of work, 5 minutes 8 seconds each.

The other reamer *B* was run at 150 revolutions per minute, with a lead of .005 inch per revolution, or at 48½ feet per minute cutting speed, and a travel of but .75 inch per minute. Here it took 11 minutes each for actual reaming time, or including all handling of work, 13 minutes 43 seconds each, or over 2½ times longer than in the first case for the whole operation, while the reaming alone took over three times longer. At this speed, reamer *B* "stood up" easily, but when the speed was increased to 228 revolutions per minute with a lead of but .0039 inch (73 feet cutting and .89 inch travel), the end of the tool burned off almost at once, necessitating regrinding the tool for every two or three spindles. Reamer *A* showed comparatively little wear after drilling forty spindles.

There are here a few considerations which merit attention. In the first place, *B* being a left-hand spiral, presents a "dragging" edge to the work where used for end boring, the keen cutting edge being, of course, rapidly destroyed. In the second place, the feed (chip) being comparatively light, there is not the tendency to heat with the four flutes as with the six; and, again, in the four-fluted reamer the flutes are large and stiff, eliminating much of its tendency to chatter and also possessing a much greater capacity for carrying away the generated heat, and still allowing ample passage spaces for chips and oil.

Then, also, the tit on reamer *B* may have so nearly fitted the ⅞-inch hole as to cause the oil-moistened chips to clog and fill in around the ends of the flutes, thus not only retaining their own heat there, but adding constantly more and more by their grinding action. And last, but not least, a "new wrinkle" was tried on reamer *A*, in the manner of grinding its end teeth. One tooth was ground in the customary manner; the next tooth was ground some .006 inch shorter than the first; the third flute some .006 inch shorter than the second, and the last the same amount shorter than the third, making it nearly .02 inch shorter than the first flute. This arrangement allowed but one cutting edge on the end of the reamer working at any one time; as that edge dulled and wore the next flute took up the cut, and so on till each edge in turn was worn out. After drilling forty spindles, the end of the reamer showed the value of the theory, for the first three flutes had worn and burned in decreasing amounts, and the last flute was just beginning to take up the end cut and would probably have stood up for ten or twelve more spindles.



A REAMER EXPERIENCE.

Some of the other data on these spindles may be of interest. The ⅞-inch hole was drilled with a flat drill at 46 feet per minute cutting speed and .004 inch lead, or .8 inch travel per minute, taking about 15 minutes each for the whole operation. On the rapid-reduction lathe the stock was reduced ⅝ inch in diameter at each cut, the travel of tool being .027 inch per revolution, or 1½ feet per minute at a cutting speed of 50 feet per minute. It took 21½ minutes each to reduce to 1-16 inch of finish sizes. In finishing to grinding size (limit .005 inch) the surface speeds ranged from 100 to 170 feet per minute, the leads from .005 to .015 inch, the tool travel from 1⅜ to 3 inches per minute, and the depth of cut from .005 to .025 inch. The average total time for finish

turning, including reaming and boring, was 1 hour and 50 minutes. Including cutting off, drilling and all handling, the average total time till ready for the grinder was 2¾ hours, and the grinding brought this time up to 3½ hours each.

The work is given not as any special record or test, for it is but a fair sample of modern practise taken from the everyday routine of the shop, and only as such does it deserve consideration. Doubtless the time could be considerably lowered and still retain the quality of workmanship required (which is high), but it illustrates, in part, what is being done in this line. T. A. S.

Machining Collars for Shafting.

Editor American Machinist:

In manufacturing plants where machinery is built thousands upon thousands of collars are needed. Many of these collars are placed on shafting which is intended to run at a high speed. It is therefore necessary that the collar shall run true. This is secured by finishing the collar all over.

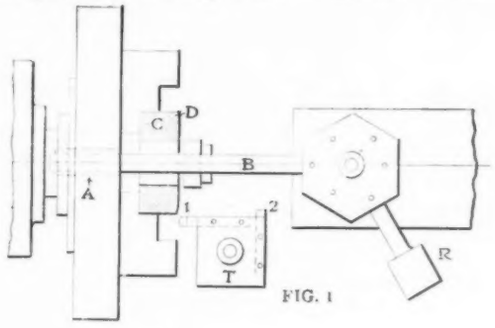


FIG. 1

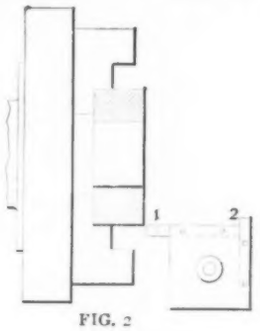


FIG. 2

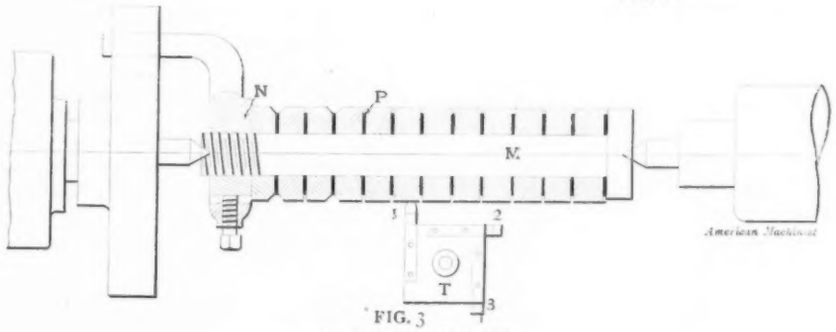


FIG. 3

MACHINING COLLARS.

These collars are cast in large quantities and usually by the aid of the molding machine. Before any machine work is done on them, it is best to put them thru a foundry cleaning mill or else the castings should be pickled.

The first operation on the collar is shown in Fig. 1. *C* is the collar which is gripped in a three-jawed universal chuck. The boring bar *B* is arranged with a double end cutter and a bearing in the bushing *A* in the spindle. The turret slide *S* is now run up by hand and the feed is thrown in after the cut is started. The tool in the cross-slide turret *T*, which is set to gage, is fed over the face of the collar at *D*. This tool is ground so that the rear edge has a flat portion which takes out the tool marks. After this, the turret tool-post is turned around and the tool 2 is used to put a slight chamfer on the corner. After the cutter bar has passed thru, the reamer *R* is used to bring the bore to size. All the collars in any given lot are treated in the same manner.

After this operation, the collar is again caught in a universal chuck with the finished face in, and the same tools as before are now used to face off the other side of the collar. The collars are mounted in pairs on a mandrel *M*, Fig. 3. A paper washer *P* is placed between each two collars and a nut *N* is used to clamp them all together firmly. The thread in the nut is of course right hand, and, as the lathe runs forward against the cut, the tendency is to lock the collars still tighter together. A tool 1 is now used for taking a roughing cut off the outside of the collars, and the tool 2 takes the finishing cut. The turret is then thrown around and the tool 3 is next used for chamfering the corners of the washers. This is a V-point tool and has a cutting edge on each side. Every other joint of the collars is then turned out as shown at *A*. The paper washer must be of sufficient thickness so that the lathe hand will have no trouble in getting nice, clean corners on the collars. By having two mandrels, the lathe hand can set one up while the cut is run over the other.

FRANK B. KLEINHANS.

Stealing Men.

Editor American Machinist:

I read the article at page 1210 on "Stealing Men" with a good deal of interest; in fact, I read it over twice. Now, while my brother "Steelwork" can bring in a lot more to prove his side of the case than I can for mine, still there are firms who do hesitate about laying off men and who often keep men when they could dispense with their services. All corporations may not have souls, but some of them have, and while we should all be loyal to the best paymaster, still we should be loyal to the firm also, regardless of what the paymaster gives us. The dollar is not all we work for, and when we find a firm that uses us white, we should stick to them even if the other fellow does offer us a quarter of a dollar more.

A case came up last month which will illustrate this point. One of the men (he was a good one, too) had an offer to go to another shop at a higher rate of wages. It looked like a mighty good chance, and he went and told the "super" about it. "Bill," he said, "you go down and look the place over and, if it looks all right and you want to take it, do so and I will fix it up here; but if you don't like the looks of things come back and your job is good as long as you want it, but I can't pay you any more wages." Bill went down and saw the job and, while the wages were all right, he did not like the looks of the place, and he came back and told the "super" he did not want to go. "That is all right, Bill, don't take it, go back to your job, it is yours as long as you want it." Why, if you were to offer Bill ten dollars a week more, he would not listen to it; but if the "super" ever leaves Bill will go too, if he can get a chance, and you can't blame him much, either. A dollar is a whole lot, but it isn't all. I like to see a man loyal to his superintendent and to the shop as well as to the dollar. If a man has got to spend one-third of his life in a place, it makes a lot of odds to him what kind of a place it is and where the place is, as well as what he gets for staying there. If I were a manufacturer I would think a lot more of a workman who says "we" made that at "our" shop than of one who flies the coop every time he gets an offer of a quarter more. No man ever changes the overalls for a boiled shirt who only thinks of what he gets for his time while he is wearing the overalls. The new clothes go to the man who does his work with a will and doesn't kick if he sends in a good idea and doesn't get promoted the same day. These sentiments may be out of date and behind the times, and I expect to get called down in good shape for this, but that never hurts the feelings of A. P. PRESS.

A watchmaker whose location is not given is said to have made the smallest electric motor in the world. The owner wears it as a scarf pin. Viewed at a little distance it strikes the observer as merely a rather curiously designed bit of jewelry and its true character is only discovered on near approach. The first thing to attract attention is the buzzing of the machine, which, by means of a current from a battery carried in the vest pocket, is kept running at a high speed with a noise like the buzzing of a bee.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

World Building, New York.

Also Published at 6 Bouverie Street, London, E. C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, World Bldg., New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by all newsdealers generally.

The AMERICAN MACHINIST CO., LTD., 6 Bouverie St., London, E. C, will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 25 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *17,200 copies are printed. Total for 1904, so far, 854,550. None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

Contents.

	PAGE
Radial Stresses Due to Centrifugal Force in Revolving Bodies	1389
Notes on the Design of Hydraulic Intensifiers	1393
Russia's Only Building at the Fair	1393
Turret Lathe	1394
Application of Scientific Methods to the Labor Problem	1394
Echoes from the Oil Country—Patternmaking in a Small Shop	1397
The Accordion Fold for Drawings and Tracings	1398
Demands for Technical Education	1398
Calculating Cone Steps and Back-Gearing by the Slide Rule	1399
The Fracture of Structural Steel Under Alternating Stresses	1400
Alcohol for Motors—II	1401
The British Weights and Measures Association	1403
Letters from Practical Men: Gas Engine Cams....A Graduating Attachment for a Gear Cutter....Dixie's Piston Rod....Steady-Rest Milling Fixtures....Lettering with the Pen....Blanking Die and Triple Operation Bender ....Machinery as Real Estate ....The Reamer	1403-1413
Legitimate Business no Monopoly	1414
Uncertainties About Steel	1414
The Fake Write-up Again	1415
Machinery as Real Estate	1415
Some New Things	1416
The Naval Liquid Fuel Report	1417
The Premium Plan in Great Britain	1418
Personal	1419
Obituary	1419

Legitimate Business No Monopoly.

Manufacturers, especially those who are sometimes assailed as members or organizers of "trusts," ought to be interested in and pay special attention to the evidence recently presented before the Interstate Commerce Commission relating to the private car lines and the use made of them to tie the hands of railroad officials, compel them to make discriminations in rates and help in the work of mercilessly robbing the public.

The evidence shows clearly that, by means of the ownership of refrigerator cars, the Armours and some other conspirators banded together, dictated their own terms to railroad officials, who perhaps would have been able to withstand the piratical attacks were it not for the ever pressing necessity of "getting business," maintaining regular interest and, perhaps, dividend payments, at any cost or at any sacrifice of principle.

Not only did the owners of the refrigerator cars control the dressed meat trade by means of this participation in the railroad monopoly, but they went into the fruit and vegetable business also; the exorbitant charges made by them for "icing cars," etc., explaining the anomalous, coexistent phenomena of low prices paid to the producers of perishable foods and the very high prices paid by consumers of those same foods living in cities. These things explain why the cost of living has risen or been fully maintained in spite of general shrinkage of business; account for much of the trouble over wages rates, stimulated by increased cost of living and, last but not least, show clearly the vital and essential difference between competitive manufacturing or commercial enterprises, however large they may be, and monopolies—lines of business in which, as in this instance, there is no possibility of competition on anything like even terms.

We have maintained, and we will insist that the most important and useful work that can be done by American manufacturers at the present time is to help to a clearer understanding than now prevails of the fact that neither large capital, large business, nor even large profits are synonymous with monopoly; that so long as new people going into a given line of business can buy materials, employ labor and ship and receive freight upon the same terms as those already in the same business there is no real monopoly. No one has a just grievance against a man or a company who builds up his or its business to large proportions so long as it is done fairly—without attempting to shut the door of competition and prevent others with capital, or brains, or both, from engaging in the same business on even terms; but every citizen, be he a manufacturer, workman or what-not, has a just grievance against those who, or rather against the system which, permits men to take an unfair advantage.

It is as sure as anything can be in this world that such doings as those recently laid bare and those of the anthracite trust and the oil trust and steel trust—real monopolies all—will sooner or later lead to some sort of remedial or perhaps retributive action upon the part of the people or their representatives. When such action is taken we do not wish to see it prejudicially affect legitimate business and manufacturing enterprises whether large or small. To the end that it may not do so, we urge machinery manufacturers, knowing, as most of them do, that they are continually meeting the most strenuous competition, to inform themselves on this question so as to be prepared to discuss it intelligently and to influence public opinion in the direction of common sense and justice.

Those who defend or attempt to justify all large aggregations of capital, regardless of the character of them, render no service to legitimate manufacturers and are pursuing a course that is as senseless as is the course of those who condemn all capital and all aggregations of it regardless of the character of them. It is the character of a business and the way in which it is carried on—whether or not it is conducted with due regard for law and the rights of others—that counts and that ought to influence the attitude of all good citizens toward it; not its size nor the amount of money made out of it, nor the wealth of its owners.

Uncertainties About Steel.

It is a curious phase of human progress that the sum of things which we don't know accumulates upon us quite as rapidly as does that of the things that we do know. While upon many points our ignorance is being dispelled, enough new and unanswered questions are continually arising upon many other points to perplex us and leave us as far from ultimate satisfaction as ever. This is true not alone regarding the newest and most advanced fields of our investigation or speculation, but also of those where we should be more or less at home and dealing with what we may consider the familiar and the tolerably well understood. We should by this time know much, and with considerable certainty, about steel, but in fact the most important particulars concerning it are still in doubt, and its most experienced and thorough investigators are as far as possible from agreement in their deductions. Things which we have thought to be definitely known and securely fixed concerning the action of steel under given conditions have had to be successively abandoned, and distrust of the material under trying conditions is still more seemly than confidence. The paper upon "The Fracture of Structural Steel Under Alternating Stresses," which we print elsewhere in the present issue, should be perused with interest, altho it is anything but a promoter of confidence. It tells a curious story of how the chemical com-

position, the physical tests and the microscopic indications have each been adopted and each successively abandoned as reliable warrants for the employment of any given steels in places of responsibility. The present paper goes still further and seems to show that the heating and cooling of steel have not such effects upon it as has heretofore been claimed and generally accepted. Upon this point a pronounced difference of statement, if not an absolute contradiction of the one by the other, is found in the utterances of two eminent authorities upon the properties of steel. Professor Stead said at Düsseldorf, two years ago, that steel deteriorated by alternating stresses could be entirely restored by simply heating it red hot and allowing it to cool slowly. Professor Arnold in the present paper says that "once a steel has assumed decisive brittleness in alternation it cannot be restored by heat treatment of any kind short of remelting." Commenting upon this curious state of affairs, *The Engineer*, London, says: "If Professor Arnold is right, then quantities of connecting rods, piston rods and such like ought to go to the scrap heap at once. If, on the other hand, Mr. Stead be right, they can at a very small cost be made as good as they ever were. Possibly, however, steel will take care that questions of this kind can never be settled. It has an unfortunate way of being all things to all men, which is, to say the least, confusing."

The Fake Write-up Again.

Our readers will recall the attention we have given on several occasions to the *Southern Trade Review*, the *Southern Review of Commerce* and the *United States Trade Reports*, all of Cincinnati, and all following the plan of sending to a manufacturer a manuscript puff of some article made by him, which puff purports to be the report of a body of experts employed by the paper and which is to be published in the paper without charge, the colored gentleman in the wood pile appearing in an offer to sell a liberal supply of the paper containing the article at "special reduced rates." This offer is made in an accompanying letter of which the apparent object is to insure the correctness of the article, the real object being, of course, to sell the papers.

The whole scheme is so transparent that it is difficult to understand how anyone could be taken in by it except on Barnum's dictum that people like to be humbugged. Of the *Southern Review of Commerce* and the *Southern Trade Review* we have heard nothing for some time, but the *United States Trade Reports* is still doing business at the old stand, as shown by the following sample of its wares which was recently offered to the Rue Manufacturing Company, of Philadelphia. It will be observed that in this specimen the old gag about an investigation by a board of experts is omitted:

"HIGH GRADE EJECTORS.

"Our policy of free investigation and reliable report on matters of business importance to our readers brings us daily many letters of inquiry on various subjects.

"Our system of ascertaining positive information has been tested too often by our subscribers, for its efficiency to be questioned, and the constantly increasing circulation of the *United States Trade Reports* is proof that it is conceded as being the leading paper of its class in the country. In the reports made in these columns we never give credit, except where we find credit to properly belong, and our statements are always based upon carefully ascertained facts.

"Among the many inquiries received lately have been several from interested patrons, on the subject of Ejectors, and we have been requested to name some firm or concern that could supply the trade with a high grade make.

"In reply we would say that we have found the Ejectors manufactured by the Rue Mfg. Co., of 215 Race St., Philadelphia, Pa., to be highly recommended by the trade as being of a superior grade.

"This make of ejectors possesses many points of value and merit, which space limit will not permit of detailed mention here; therefore, we would advise all interested to address them direct for full particulars.

"We are thoroughly convinced that these ejectors will answer your purposes admirably, and that their quality and finish will surprise and please you, as has been the case with many who have investigated their merits.

"This company is well known for business tact and enterprise, as well as sterling integrity, and their standing commercially is of the highest order. They are conducting a very large business, having a patronage that extends to all parts of the country, and which is constantly increasing owing to the great value of their products and their honorable methods pursued in managing their business."

Accompanying this manuscript was the following letter to the Rue Manufacturing Company. The request that they "add to or alter same as you may think best" will not be overlooked:

"The article we enclose you is an editorial prepared in answer to inquiries on the subject of Ejectors. As we have highly indorsed your make of ejectors, and as we desire to be as correct and comprehensive as possible, we ask that you add to or alter same as you may think best, and return as soon as possible. If you have any cuts that will illustrate the subject, kindly loan them to us and we will return them promptly.

"As this is an editorial of course there is no charge for the publication, and if in addition you can use any extra copies of the issue in which it will appear, we will be pleased to make you the following special reduced rates, as we are desirous that you should get as much benefit out of it as possible.

"The price of the *United States Trade Reports* is 15 cents per copy, but we can supply you with 100 at 12 cents, 250 at 10 cents, 500 at 9 cents, or 1,000 or over at 8 cents per copy, shipped to you. Or, if you will send us a list of names of those whom you wish to reach, we will mail marked copies to such, without any extra charge to you for the postage, wrapping, addressing or marking.

"Although the publication does not depend on an order for copies, such an order will be appreciated by us.

"Awaiting an early reply with corrected copy, we remain, with best wishes."

Some very ludicrous instances of the manner in which these papers miss their mark have been related to us, the most recent one being the case of a new brand of steel of which not a pound had then been placed upon the market and of which it was impossible that anyone outside the works where it was being developed could possibly know anything more than its name.

Machinery as Real Estate.

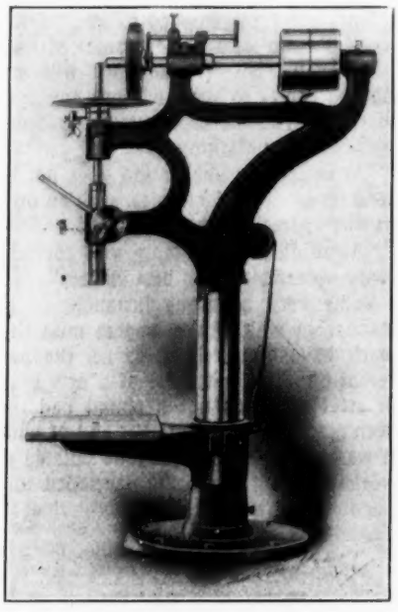
The AMERICAN MACHINIST notes a British case where the purchaser of a power plant, not yet paid for, placed a mortgage upon his property, including in it "buildings, fixtures, machinery and fittings erected thereon." When the engine builder attempted to remove the engine on account of default of payment, he found that it belonged to the holder of the mortgage, because the engine was bolted to a concrete foundation and was thereby made a part of the real estate. *The curious thing about it, of course, is that one who has never acquired title can transfer it to another party.* Our contemporary imagines that the law here is very similar. It is, altho in different States the views of the courts have not been uniform. In one case a smutter in a mill was taken from its rightful owner in practically the same manner, while in another case it was held that a boiler and engine were not fixtures as against one who held a prior lien. The law in this country is uncertain enough so that all parties to such transactions should be on their guard.—*American Miller.*

An experimental trial has been made on the North Eastern Railway between Walker Gate, *via* Tynemouth and Benton, to Newcastle, England, with a new electric locomotive which will be used to haul goods trains from the low-lying quayside up a very steep incline to the higher level. The experimental train consisted of eighteen 10-ton trucks of coal, two vans, and an ordinary steam locomotive in case of accident or breakdown. The total weight of the train, excluding the electric motor, was upward of 390 tons.

Some New Things.

A NEW BENCH DRILL.

The drill here shown, altho designed for light drilling, takes in work of considerable size, the limit of vertical hight between table and spindle being 12 inches



A NEW BENCH DRILL.

and the "swing" 15½ inches. The normal speed of the spindle ranges from 200 to 1,500 turns per minute, this being easily adjusted by sliding the friction driving

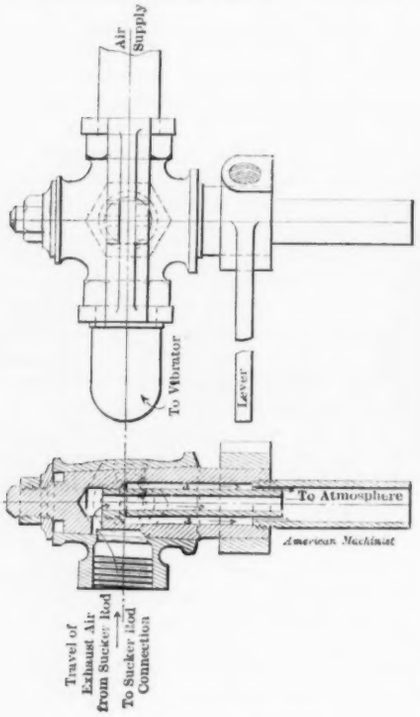


FIG. 2. THE AIR EJECTOR.

wheel in or out on the face of the disk. This disk or friction plate runs in a ball bearing on the main frame. It is brought into contact with the driving wheel by an eccentric ring easily and quickly moved and locked in position. The driving wheel is built up of paper clamped between disks. A ball-bearing thrust collar on the spindle removes practically all friction there. A special advantage of this friction drive is that the drive is strongest for the larger drills and the slower speeds. The table is counterbalanced by a weight in the hollow column. It can be easily raised or lowered, swung to either side and locked by a wrench which is always there. The drill is built by the Patterson Tool & Supply Company, Dayton, Ohio.

The lifting of the patterns is accomplished by means of a suction head which is brought into contact with the board or flat surface of the pattern before mentioned. The lift is in a straight line, and deep difficult draws are accomplished almost as quickly as shallow ones.

Lately a new feature in the shape of an air ejector has been added to this machine so that it is not now necessary to have a vacuum plant in connection with it. The machine is operated by air at about 60 pounds pressure. In using the ejector the lever attached to the sucker rod is brought down, causing a lever to strike a lower tappet pin (secured to a rod held rigidly to the frame of the machine), thereby admitting the compressed air which, passing rapidly over the sucker rod, creates a vacuum as soon as the sucker head comes in contact with the pattern. The air then passes thru the plug and thence to the vibrator. When the pattern is raised, an upper tappet pin strikes the lever, cutting off the air and thereby breaking the vacu-

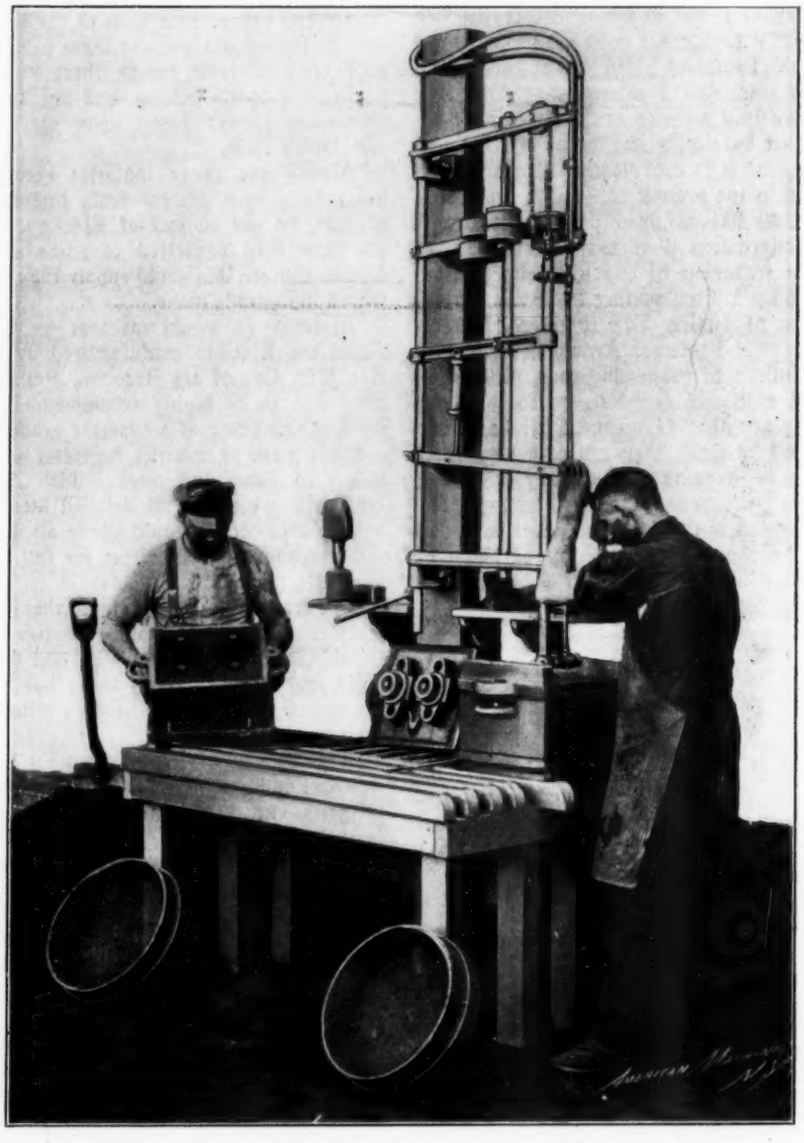


FIG. 1. GENERAL VIEW OF THE VACUUM MOLDING MACHINE.

VACUUM MOLDING MACHINE.

Fig. 1 is a general view of the molding machine built by the Bryan Vacuum Molding Machine Company, of Lockport, N. Y. With this machine wooden patterns can be used; it being necessary only to attach the patterns to boards doweled to fit the flasks, except where the patterns have flat sides large enough for the suction head to take hold, in which case no board is required. No squeezer is incorporated in the machine, but if desired can be applied.

um. With air pressure at 60 pounds, a vacuum of 21 inches is obtainable, which is capable of lifting a weight of about 140 pounds with a sucker head 4 inches in diameter. Fig. 2 shows the air ejector in two views, one in full line and the other in section.

PNEUMATIC DECK-CAULKING MACHINE.

This machine consists of a Keller pneumatic riveter, mounted upon a frame on

PNEUMATIC DECK-CAULKING MACHINE.

wheels and provided with a sharp-edged disk for caulking with oakum, or similar material, flat surfaces, such as decks, piers, etc. The oakum is carried on a reel, and the machine is so arranged as to unroll and hammer it into the seam as the machine is wheeled along; the vibration of the machine assists in moving it. It is obvious that this machine will save a great deal of hard labor and is much faster than the old hand method. It is one of a number of devices especially adapted to shipyard work and recently brought out by the Philadelphia Pneumatic Tool Company, Philadelphia, Pa.

PORTABLE DRILL WITH MAGNETIC "HOLD-ON."

The half-tone shows a portable drilling outfit with motor and flexible shaft for driving the drill, and a magnetic "hold-on" for securing the "old man" to the plate to be drilled, the device being of especial value to steel plate and armor manufacturers. It may be readily moved to any part of the plant and the magnet attached and detached quickly; it will operate satisfactorily under water, and is powerful enough to drill a 2-inch hole. Coates Clipper Manufacturing Company, Worcester, Mass., is the maker.

Two-thirds of the world's output of coal-tar products comes from Germany, the value of these manufactures amounting to $36,000,000 for the year 1900.

The Naval Liquid Fuel Report.

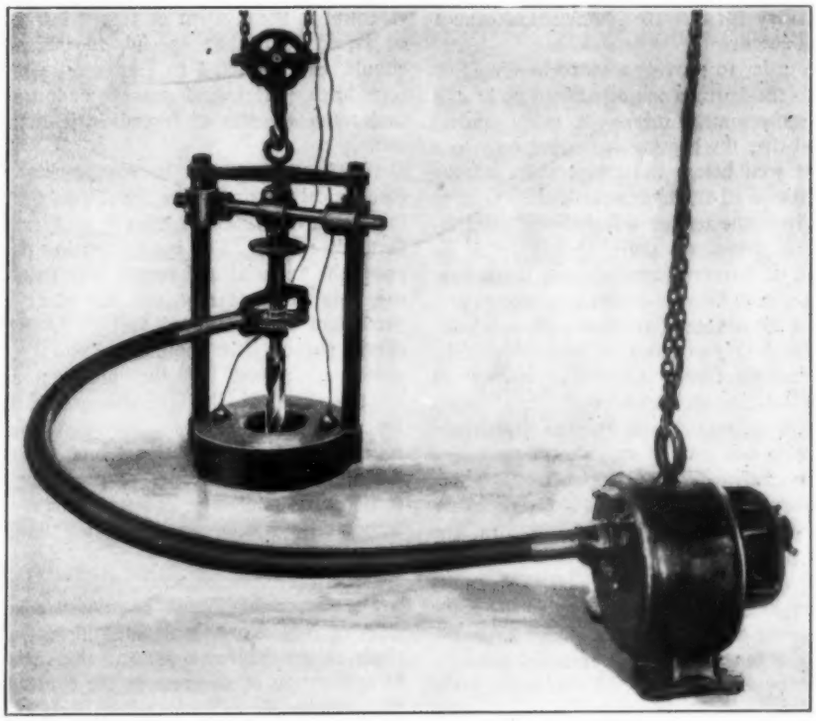
The bulky report of the United States "Liquid Fuel" Board represents a vast amount of faithful and diligent experiment and investigation and records results of great and permanent value not only to the naval and maritime world, but to commercial and manufacturing interests generally. The board consists of Commander John R. Edwards, Lieut. Commander W. M. Parks and Lieut. Commander F. H. Bailey, and the report is signed in approval by Rear Admiral Geo. W. Melville while still Chief of the Bureau of Steam Engineering.

The experiments upon which the report is based continued uninterruptedly for twenty-eight months, and for a considerable portion of this time there were no fewer than six commissioned officers giving special consideration to the subject. There were also employed in connection with this duty skilled draftsmen and experts of the Bureau of Steam Engineering, as well as members of the bureau's clerical staff. For one year there were available also the entire crew of the torpedo boat "Rodgers." The board was also in correspondence with nearly every interest directly or indirectly concerned with the use of oil as a combustible. The report says: "The cost involved in the installation and operation of the experimental boiler plant, combined with the direct and indirect expenditure incurred by individuals and the Navy Department in conducting the extended series of tests, probably represents the largest outlay ever incurred by either private, corporate or official interests in the thorough investigation of the important problem of determining the possible future field for the use of crude petroleum as a fuel."

From the mass of conclusions arrived at we abstract those of general interest, and not those dealing specifically with naval conditions:

No difficulty should be experienced by an intelligent fireroom force in burning oil in a uniform manner. It need likewise require but little experience upon the part of skilled water tenders to be able to form an approximate idea both as to evaporative output and efficiency conditions.

For general purposes on shore, high-pressure steam is a more satisfactory



PORTABLE DRILL WITH MAGNETIC "HOLD ON."

spraying medium than air. The necessary increase of the evaporating plant is practically the main objection to the employment of steam as the spraying medium for liquid fuel on board naval and merchant vessels.

While the use of steam as a spraying medium will undoubtedly prove most satisfactory for general purposes, the results of the tests show that the consumption of fuel oil cannot be forced to as great an extent with steam as the atomizing agent as when highly heated compressed air is used for this purpose. The advantages of air as the best spraying medium for severe forced-draft conditions, is due to the fact that this atomizing agent, after entering the furnace, is a supporter of combustion. With the use of steam as the atomizing agent the rarefied vapor simply displaces a certain portion of air that is requisite for complete combustion.

In every oil-fuel installation special provision should be made for the removal of the water that will collect from various sources at the bottom of the supply tanks. Even a small amount of water pumped to the burners will interfere with the efficient and satisfactory work of an oil-fuel installation.

The evaporative efficiency of crude and refined oil is practically the same, no matter from what locality the oil may come. The danger of using crude oil, however, is much greater.

The great benefit of heating the air necessary for effective combustion cannot be doubted.

In order to provide a uniform supply of oil to the burners the oil should be heated by some simple means, it being understood that the heating is carried only to a point well below the temperature of the deposition of the hydro-carbons.

Where the use of a ljquid-fuel installation is projected, there should be a reserve of burners installed, and these burners should be of a design that would permit rapid examination, thorough overhauling, and easy renewal of special parts by the fireroom force. Careful experiment, as well as extended experience, has shown that by increasing the number of burners there is not only a more uniform but a more efficient distribution of flame. There is also a minimizing of the blowpipe effect, as well as a marked reduction in the amount of noise in the furnace.

The hygrometric state of the atmosphere has a noticeable influence upon the efficiency and capacity output of boilers.

In order to secure in oil-fuel installations more uniformity of conditions in the furnace, and to decrease the noise where air is used as a spraying medium, an air-cushion tank for the oil-supply pump should be installed.

In view of the liability of every form of burner to clog, the necessity of making special provision for straining the oil was emphatically shown.

Extended experience in the burning of crude oil will confirm the opinion that the simpler the furnace the greater its efficiency.

The efficiency of oil plants will be primarily dependent upon the character of the installation of fittings and auxiliaries. The form of the burner, so long as it is manufactured in accordance with general well-known principles and all its parts are accessible for overhauling, will play a very small part in extending the use of crude petroleum.

Where crude petroleum has undergone a light refining or distillation no ill effects result to modern steel boilers. From the standpoint of endurance of the boiler the advantage, if any, is with oil. Crude oil, however, by reason of its searching and corrosive effects, has a greater tendency than refined oil to attack the seams and tubes of modern boilers.

With the use of oil the forcing of a marine boiler should be much more readily accomplished than with the use of coal.

Under severe forced-draft conditions and with water-tube boilers and with the use of oil as a fuel the solution of the smoke question is nearly as remote as ever.

Practically every form of commercial firebrick that was used in the boiler for the purpose of forming a deflecting arch disintegrated either under the action of the intense heat generated, or due to the action of the acids in the oil or coal. In case any form of arch or bridge wall is essential to the efficient or forced burning of liquid fuel, then special experiments should be conducted to secure a refractory brick that would possess endurance under the severest of forced-draft conditions.

The board regards the engineering or mechanical feature of the liquid-fuel problem as having been practically and satisfactorily solved. For manufacturing purposes the financial and supply features are the only hindrances to the use of crude petroleum as a standard fuel. For mercantile purposes the commercial and transportation features of the problem are existing bars which limit the use of oil fuel in merchant ships. For naval purposes there is the additional and serious difficulty to be overcome of providing a satisfactory and safe structural arrangement for carrying an adequate bunker supply.

The September issue of *The Cement Age*, of New York, is devoted almost entirely to the extensive use and the variety of application of concrete in the construction of the New York subway. It contains articles from William Barclay Parsons, the chief engineer of the Rapid Transit Commission, and from all the division engineers. It shows that the use of concrete accomplished a great saving of time and money and enabled much of the work to be done by labor less skilled than would otherwise have been required. Many interesting views are given of the work at various points in different stages of the work.

The Premium Plan in Great Britain.

At page 1382 we referred to the condemnation of the Premium Plan by a committee of the Engineering and Shipbuilding Trades Federation and we give below a portion of an editorial thereon by *The Engineer*, of London:

"The committee which has reported adversely on the premium system is very mixed, but it has at its head the boilermakers—a powerful and aggressive body—which has from the first shown violent opposition to any change from existing methods. The committee expresses its dislike to anything but payment by the hour or, under certain conditions, piecework. That is to say, it disapproves entirely of anything that may stimulate a workman to emulate his fellows, or earn an extra reward."

After giving the extract from the report which we quoted in our previous article, *The Engineer* goes on to say:

"To all of these charges there is only one suitable reply, that is an unqualified negative. The system has much to recommend it, as the men who are working under it willingly admit; it is in no sense degrading, unless all desire to receive reward for exertion is degrading; there is no jealousy or ill-feeling between the men who work under it, tho those who have refused its benefits may be envious of those who enjoy them; the calculations are as simple as those involved in the purchase of vegetables or meat; it has not been, nor ever will be, of itself the cause of the discharge of large bodies of men, and it is no harder on old or incompetent men than any other system of payment. The other charges advanced against it show equal ignorance of the system. It is suggested that since the men have no voice in the settling of the time rate there must be unfairness; but it is obvious that the system defeats itself if no premium is earned, and hence in every case in our experience a liberal time allowance is made. It is furthermore alleged that increased efficiency is not secured; to which the resolution of those employers who have once used the premium system to adhere to it is sufficient answer.

"But perhaps the profoundest ignorance of the system is found in the observation that if a great turnover is obtained the employer ought to be satisfied with the profits on that turnover, and not seek also to obtain profit by making the workman's increased activity a reason for reducing his wages for a particular piece of work; and that while the employer is entitled to the full benefit of the productive capacity of his machinery, the workman is also entitled to the full reward of his labor. There is in these sentences such a profound misconception of the whole thing that one is

at a loss to know where to begin to set it right. We imagine that the whole object of working is to obtain wages, and if the master makes an arrangement by which his workmen are able to earn more per day or per week than they did before without working longer hours and without excessive exertion, it is difficult to see why they should bother their heads about the wages cost per piece. Moreover, they admit that the employer is entitled to the full benefit of the productive capacity of his machines, and yet they complain when he offers to pay them a premium for giving him what they admit is justly his! If every workman exerted himself to his full capac'ty for day wages, we should certainly hear of neither piece nor premium systems; but since that is expecting too much of human nature, those systems have been devised to offer him an automatic inducement to hard work, and since the premium system is free from certain objections which belong to piecework, it has received the seal of approval of many large employers and of the most large minded of engineering trade unions, and of the most intelligent and ambitious workmen. It has, indeed, made such progress in industrial centers that, in spite of adverse reports of special committees and all the machinery of opposition that may be brought against it, it is likely in the end to gain both the hearty support of employers and employed; for we may rest assured that not for any extended period will a large body of workmen remain so blind to its own interests as obstinately to refuse the benefits which many of its members already enjoy."

Personal.

Rear-Admiral George W. Melville, retired, and John M. MacAlpine have opened offices at 615 Walnut street, Philadelphia, as naval architects and consulting engineers.

H. J. Hilgendorf has resigned his position as foreman of the tool department of the Remington Arms Company, Ilion, N. Y. His associates in the tool department presented him with a gold watch-chain as a mark of esteem.

Col. H. G. Prout, first vice-president and general manager of the Union Switch & Signal Company and former editor of the *Railroad Gazette*, has been elected a director of the Westinghouse Air-Brake Company in place of Henry Oliver, deceased.

Obituary.

George S. Eaton, inventor of the Eaton type-finishing machine, the Eaton oil-cloth binder and other devices, died in Brooklyn, October 10, sixty-four years old.

Henry R. Lewis, superintendent of the carpenters and patternmakers of the American Steel & Wire Works, Braddock, Pa., died October 6, fifty-three years old.

Carl Ernst Betrand, inventor, in conjunction with E. T. Thiel, of the Betrand-Thiel process for the refining and improvement of Bessemer steel, died at Kladno, Bohemia, October 7.

Henry A. Gouge, inventor of the safety car-heating apparatus which bears his name, and of ventilating devices for schools and public buildings, died at Hartford, Conn., October 9, seventy-six years old.

Charles J. Smith, a well-known inventor and manufacturing machinist, died in Milwaukee, October 6, eighty-three years old. Mr. Smith came from England in 1843, located in Milwaukee and soon thereafter started a machine shop, which he later sold to give his attention to the development of his inventions. He started another shop for the manufacture of hardware specialties. This business continued to grow until in 1891 it was incorporated as the C. J. Smith & Sons Company and the plant now occupies an entire city block. Mr. Smith leaves three sons each at the head of a large manufacturing business in Milwaukee.

Manufacturers.

Springfield, O., has been trying to secure shops of the Detroit Southern.

The factory of the Flat Rock (Ind.) Canning Company has been burned.

The factory of the Flat Rock (Ind.) Canning Company has been burned.

L. J. Baldwin, of Marion, Ind., *et al.* may establish an ice plant at Wabash.

A shoe factory of Alden, Walker & Wilde, Middleboro, Mass., has been burned.

The Waiontha Knitting Company, Richfield Springs, N. Y., is to have enlarged facilities.

Edward Brooks, Rochester, N. Y., has filed a petition to erect a large furniture factory.

T. C. Lee will construct and operate a barrel, crate and basket plant at South Norfolk, Va.

A large manufacturing building is to be built by the Larkin Soap Company, Buffalo, N. Y.

The Lowell (Mich.) Specialty Company is installing metal-working machinery at its factory.

A new car barn and repair shop will be built by the Scioto Valley Traction Company, Columbus, O.

Mickle, Dyment & Son, Brantford, Ont., planing millers, are said to be contemplating an extension.

Work has begun on the foundation for the Muskegon (Mich.) Pressed Steel Boat Company's factory.

A. L. Blatchley, of Whitehall, Ill., *et al.* propose to build a brick-making plant near Chanute, Kan.

Alexander Smith, of Leamington, Ont., thinks of building a stave factory at or near Sault Ste. Marie.

The Damon & Howe Comb Company will build an annex to the factory on West street, Leominster, Mass.

The Paris Mountain Water Company proposes to construct a temporary plant for Greenville, S. C.

The Emery Slate Picker Company, of Green Ridge, Pa., finds it necessary to make an addition to its plant.

A big gas plant is to be erected at Glenwood, L. I., by the Nassau Light & Power Company, of Roslyn, L. I.

The plant of the Chicago Car & Locomotive Works, at Hegewisch, Chicago, Ill., has been somewhat damaged by fire.

Simmonson Brothers Manufacturing Company's sash and door factory, Minneapolis, Minn., has been burned.

F. E. Kinney & Co. are starting a repair machine shop in the Averill block, at 23 South Main street, Barre, Vt.

A five-story, 78x100-foot factory is to be built for M. Schrayer's Sons & Co., hardware, tinware, etc., Chicago.

A new plant is to be built at Thirtieth and Lombard streets, Philadelphia, for the United Water Improvements Company.

Three buildings of the United Zinc & Chemical Company, Kansas City, Mo., at Argentine, Kan., have been burned.

T. J. Davis, of the Chesapeake Stone Company, will install at once a $75,000 rock crushing plant near Oslesby, Ga.

The plant of the Blakeslee Lumber Company, Albany, N. Y., manufacturer of sashes, doors and blinds, may be enlarged.

Gregory G. Wright & Son, manufacturers of stencils, stamps, etc., Cincinnati, O., have bought a site for a 46x60-foot factory.

At Ferriday, La., a new town in Concordia Parish, the Texas & Pacific Railroad will, it is understood, build small repair shops.

Jos. Wilcox & Co., manufacturers of celluloid goods, Athol, Mass., will occupy new quarters and purchase additional machinery.

Work has begun on a $16,000 building for the Diamond Iron Works, Minneapolis, Minn., to be used for offices, pattern shop and warehouse.

Ground is being broken for the erection of a car barn and repair shop for the Central Pennsylvania Traction Company, Harrisburg, Pa.

The Windham Manufacturing Company, Willimantic, Conn., is understood to contemplate building an addition, to be used as a weave shed.

The contract has been awarded for a machine shop for the Peerless Motor Car Company, Cleveland, O. It will be two stories, 60x150 feet.

The American Hoist & Derrick Company, St. Paul, Minn., has bought 150x97 feet of land at Chicago for a warehouse, to cost about $100,000.

It is stated at Augusta, Ga., that Walter M. Jackson is connected with the proposed establishment of a cotton mill on North Augusta Heights.

A sawmill, planing mill and two dry kilns of the Indiana Lumber Company, Nashville, Tenn., have been burned, and probably will be rebuilt at once.

C. A. Dunham Company, Marshalltown, Ia., manufacturer of the Dunham steam trap, is in the market for a small dynamo, direct-current, 110 volts.

Marshall & Co., thread manufacturers, Kearny, N. J., have installed and tested two 1,000-gallon-per-minute pumps in readiness for Passaic River floods.

A number of practical foundrymen are thinking of starting a small foundry and machine shop at Apollo, Pa., and may lease the old Kowalski machine shop.

The Board of Trade, Wilmington, Del., has had in communication a concern which is looking for a site for a plant to manufacture safe locks or safes and locks.

Hammacher, Schlemmer & Co., hardware, tools, supplies and piano materials, New York city, have moved to larger quarters at Fourth avenue and Thirteenth street.

The machine shop of the Perkins Machine Company, Warren, Mass., is being operated night and day to complete work on presses for the Japanese Government.

The Union Pacific is said to be about to begin the enlargement of its shops at Ogden, Utah. It is also in view by the company to enlarge the shops at Salt Lake.

A big carbon paint plant is to be established near Nashville, Tenn. J. S. Henderson, of Nashville, is prominently interested. Machinery for it is now being built.

It is thought that the Lawrence (Mass.) Machine Company may locate in Beverly, Mass., and double its capacity. Some other places are understood to be considered.

A permit has been granted for a factory, building, 60x102 feet, at the plant of the Conkling-Armstrong Terra Cotta Company, Philadelphia. The cost will be $12,000.

The Metal Stamping Company, West Niagara street, Niagara Falls, N. Y., has started work on a two-story and basement, 60x104-foot building to be completed December 1.

Ground has been broken for the erection of a six-story plant of the Pittsburg Stove & Range Company on Preble avenue, Allegheny, Pa. An iron foundry will also be erected.

The Pacific Sheet Metal Works has bought from the American Can Company property at Astoria, Ore., on which it is believed that the former concern will establish a can factory.

Land in South Schenectady, N. Y., has been sold to a Towanda, Pa., man, and there is rumor that it will be used partly for a large branch plant of the Scranton (Pa.) Stove Works.

There is prospect for the establishment of a large plant at Houston, Tex., by the Otis Elevator Company, New York City. Reports from that place indicate that the project is going thru.

The Board of Trade, Weatherly, Pa., is arranging with a Mr. Siddel, of Lebanon, boiler manufacturer, to bring there a plant now located at Christiana. The building will be 40x150 feet.

The Southern Manufacturing Company, Savannah, Ga., which is starting up a new excelsior plant, expects later to enlarge and take up side lines, such as the manufacture of mattresses.

A Cleveland, O., report says that a big shop is to be built at Louisville, Ky., for the Louisville & Nashville Railroad Company. It will cost $2,500,000, and there will be 13 acres under one roof.

The Canada Furniture Manufacturers, Limited, Toronto, Ont., are considering the erection of a new factory in Seaforth, Ont., to be used for the manufacture of interior fittings, overmantles, etc.

The Liberty Manufacturing Company, maker of boiler tube cleaners and oil filters, Pittsburg, Pa., has bought a 104x100-foot lot, on which it is believed that a manufacturing plant will be built.

It is thought that the Rochester Shaft Coupling Works, in which G. H. Estes is interested, will come to Cuba, N. Y., in the near future and will run in connection with the pulley works which are now in operation.

The Defiance Iron Works Company, of Syracuse (N. Y.?) has written submitting a final proposition for the establishment of its factory in Chatham, Ont. It was referred to Industrial Committee to prepare a by-law.

Robert Brown desires to form a stock company in West Chester, Pa., and start a factory in the old machine shop, on North Walnut street, belonging to Joseph N. Marshall, for the manufacture of a patent burglar alarm.

The Columbia Basin Stockyards Company (capitalization $50,000) has been formed to build a large packing plant at Portland, Ore. George T. Myers is president; J. J. Cahill, vice-president and general manager; P. L. Willis, secretary.

It is stated at Milwaukee, Wis., that T. J. Neacy, Charles Backstrom and Walter Reed are interested in the Backstrom Engine Company, which has been recently incorporated. A new plant for the manufacturing of turbine engines is to be built.

A big company is said to have been formed with a view to leasing and enlarging plants in various places of the Montello Brick Works, Reading, Pa. A further plan is to build new plants in New York, Pittsburg and Washington, D. C.

The Susquehanna Electric Company, of which B. Harry Welch, of Philadelphia, is president, proposes the construction of a plant on the river, which is estimated to cost $9,000,000, and would probably furnish current to Baltimore, Md.

The Western Brass Manufacturing Works, brass, bronze and iron hardware, Chicago, has moved into its new factory, 47 to 51 North Elizabeth street, near Lake street, and is in shape to fill orders promptly. A large variety of patterns is on hand.

Charles L., Louis and William Bauer have purchased the interest of President R. H. Foos, of the Foos Manufacturing Company, Springfield, O., manufacturer of corn harvesters and shellers, grinding and crushing machinery, portable forges, etc.

It is stated at Moline, Ill., that the Nyquist Machine Company, which has been doing business at a shop on Thirteenth avenue, has outgrown its quarters and erected a building on Fifteenth street for general machine work, nickel plating, die and pattern work.

The executive offices of the Niles-Bement-Pond Company in New York city will be removed May 1, and will occupy the entire thirteenth floor of the new Trinity Building, 111 Broadway. There seems to be a general tendency for engineering firms to take offices in this building.

Newcastle, Colo., people have incorporated the Grand Valley Canning Company with a capital stock of $50,000. It is the purpose to erect a factory this winter. C. A. Hahn is president; James Duce, secretary; G. H. Norris, superintendent, and Samuel Doll, general manager.

The Raritan Brick Company has been formed and bought a 20-acre site. T. R. Eskeson is president; Karl Matthiason, vice-president, and Theodore S. Brown, secretary and treasurer. Two of these are connected with the New Jersey Mosaic Tile Company, of Matawan, N. J.

A plant and foundry are being erected for the Pittsburg Engineering Company, at East Butler, Pa. The first building to go up will be a machine shop and foundry. The members of the company include H. B. Redding, G. P. Thurber and A. L. Schultz. Three hundred men will be given employment.

The Firth-Stirling Steel Company agency at 53 North Desplaines street, Chicago, Ill., announces that the railroad department of the agency is now under the general charge of C. F. Blue, Jr., with headquarters in Chicago and St. Louis. One of the company's specialties is "Blue Chip" high-speed steel.

The Wellman-Seaver-Morgan Company, engineer and manufacturer, with general offices at Cleveland, Ohio, and plants at Cleveland and Akron, Ohio, announces that on October 1 it opened a New York office, having taken a suite of offices at 42 Broadway. Geo. B. Damon has been appointed New York manager.

Henry Parsons & Son, Marlboro, Mass., manufacturers of machinery, will be incorporated under the laws of Massachusetts as a stock company, under the name of the Parsons Machinery Company, of Marlboro. Gen. Parsons will be president of the new company. Several selling agencies will be established.

The Baltimore (Md.) Electric Power Company has been incorporated by Messrs. John T. Stone, president of the Maryland Casualty Company; David E. Evans, president of the Maryland Telephone Company, *et al.* The new company is to construct the power and light plant of the Maryland Telephone Company.

The Stirling Company, water tube safety boilers (general offices, Pullman Building, Chicago, Ill.) has appointed Fred'k A. Scheffler special representative, with headquarters in its New York office, Engineering Building, 114 Liberty street, New York. Mr. Scheffler will be associated with A. L. Rogers, district sales manager.

The Gravity Iron Works, about to be incorporated, have been negotiating to take over the Carbondale Metal Works, near Carbondale, Pa. The new concern is largely composed of Scranton, Pa., and Binghamton, N. Y., capital. Daniel J. Slowe, an experienced machinist and metal-worker, will be superintendent and manager.

The Berkshire Automobile Company, Pittsfield, Mass., has been organized with a capital of $15,000. Dr. Wm. J. Mercer is president; Frank H. Whyland, vice-president; F. A. Cooley, treasurer, clerk and general manager; Clarence P. Hollister, superintendent. The company now has rooms on Cottage Row and plans to build a plant.

General Alexander Hughes, of Minneapolis, Minn., is prominent in a concern which will establish a coal briquetting plant at Lehigh, near Dickinson, N. D. It bought the right to make the machinery, which is such as used abroad, with some improvements of its own. The briquettes will be egg shape, and they are claimed to be the equal of anthracite.

A metal-framed wire window screen manufactory, of which W. R. Cochran, Jr., is general manager, has been moved from Decatur, Ind., to the Forgie Building, on Hall avenue, Washington, Pa. Patents for adjustable and roller screens, which Mr. Cochran has, may be taken up by the concern. A stock company with $50,000 capital stock is organizing.

Henry Yewell Bready is quoted at Baltimore, Md., as announcing that he has incorporated the Consumers' Boxboard & Paper Company at Trenton, N. J., with an authorized capital of $150,000, and a plant is to be established near Baltimore. George A. Hoffman is president of the company; Elmer E. Weaver, vice-president and general manager; Mr. Bready, general counsel.

Options on three buildings in Little Falls, N. Y., have been secured by a company organized for the manufacture of storage batteries, negotiations being conducted by J. M. Kingsbury, brother of ex-Mayor E. H. Kingsbury. Associated with him in the enterprise are Messrs. Smith and Knapp, of Binghamton and Schenectady respectively. Mr. Kingsbury has been connected with the General Electric Works.

It is stated at Montgomery, Ala., that, replying to an invitation of the Alabama Commercial & Industrial Association to build a plant in the South, President Hoadley, of the International Power Company of New York, wired that he is looking into the Southern situation, and is much attracted to the South for manufacturing. "Will undoubtedly avail ourselves in the near future of propositions duly presented."

It is stated at Fort Wayne, Ind., that the Wayne Gear & Machine Company (capital $10,000) has been organized. Its purpose is declared to be the manufacture and sale of transmission gears and other mechanical devices, automobiles and their parts, and in a general way to make and deal in machinery. The directors for the first year are Dr. Maurice I. Rosenthal, Joe Freiburger and Louis Frankel.

The Geometry of the Square-Thread Screw.

BY FERDINAND PEAM.

The square thread screw is a piece of mechanism well known to every mechanic and one which is employed more or less on 90 per cent. of all machines one finds in the machine shop. Its mechanics and manufacture are treated in every engineering text-book and taught in every technical school; yet we find that probably not 10 per cent. of the turners employed on screw-cutting lathes have any clear conception of the influence on the form of thread produced by using tools other than the ordinary parallel sided tool set in the tool-post, with its top surface perfectly level and at the same hight as the centers.

It will be well here, to avoid confusion, to enumerate the nomenclature followed herein. The commonly accepted definition of a square thread screw, and the one upon which this article is based, is that of a screw in which, if a longitudinal section be taken cutting the axis, the threads and grooves will present a form which is truly square. This section is hereafter referred to as the *axial section*. *Normal section* is defined as that given by a plane cutting the thread or groove at right angles to its

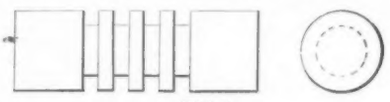


FIG. 1

FIG. 2

FIG. 3

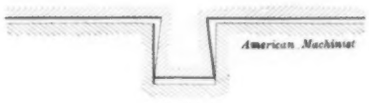


FIG. 4

SHOWING THE IMPOSSIBILITY OF SQUARE THREADS OF INFINITE PITCH.

helix at any given distance from the axis. *Helix angle* is the angle made by the helix with the *axis* of the screw, and is synonymous with the angle of spiral adopted by Brown & Sharpe in their Treatise on Gearing. The term *pitch* (productive of costly mistakes and much profanity) is tabooed altogether, and I take this opportunity of endorsing the pertinent remarks of Ernest J. Lees at page 875, Vol. 26, regarding this. The term *lead* is substituted and is defined as the axial advance of the nut along the screw per revolution.

Such a tool, as before mentioned, can, of course, only be used where the helix angle is not less than about 80 degrees, owing to the following edge presenting a bad scraping angle to the work, and the leading edge being correspondingly weakened by the large amount of side clearance necessary.

When a screw having a less helix angle than 80 degrees is called for, other means of cutting must be adopted; and it is to the subject of screws having helix angles less than this (about 45 degrees being the least angle called for in practise) that this article is devoted.

There are two practicable methods open to us; the first is to rough out the grooves to approximate form, and then finish each side separately with a straight side-tool tilted over so as to present a proper cutting angle to the work, and with the cutting edge at the same hight as the centers. The bottom of the groove is not so important and may be finished with a square-nosed tool. By this means a groove can be formed which is truly square in axial section.

This method becomes a necessity in large screws, but presents difficulties where multiple threads are employed, as it is not easy in screws of long lead in proportion to diameter, or, as is sometimes termed, "steep pitch," to measure accurately the width of threads and grooves along a line parallel to the axis, and unless this is done the nut cannot be made a good fit, except it be cast on.

The other method, which may be adopted in the case of medium and smaller screws, is to cut, or at least finish, the whole of the groove with one tool, tilted over in the tool-post so as to bring the top surface as nearly as possible normal (*i. e.*, at right angles) to the helix. This enables the last finishing cut to be taken along each groove without moving the tool in the tool-post, by slipping the change wheels out of gear after finishing each groove, and indexing around for the next, in the manner well known to turners. If this is correctly done, the grooves are properly spaced out and the screw will fit the nut equally well when the threads are started in any of the grooves in the nut.

It is well known that a parallel-sided tool of width equal to the width of groove measured along the axis, when tilted over in this manner, so that the two side cutting edges are equally above and below the hight of centers, does not produce a square thread, but one which is undercut in both axial and normal section to an extent varying with the helix angle; but when one casts about for information as to what form the tool *should* take, he finds that it is scarce, meager, and sometimes even delusive. Hence the writing of this article, which it is hoped will be of some interest to every reader of the AMERICAN MACHINIST who has not already investigated the subject for himself. I have endeavored to introduce as little mathematics as possible and to demonstrate the subject graphically in order that the arguments used may be followed by anyone possessing an ordinary knowledge of projection.

In a recently published book, "The Working of Sheet Metals" by R. B. Hodgson, the author of it comments on the unusual amount of end slogger [back lash] exhibited by fly-press screws, even after a few weeks' service, and devotes a short chapter to the subject of the screw. In this he explains the undercutting which is shown in a normal section of a square thread, by two illustrations—Fig. 1, which is put forth to represent a (presumably) 4-threaded screw of zero lead, and Fig. 2, the same screw but of infinite lead. That this does not fill the bill is shown by the fact that these articles are not square-thread screws nor can they be accepted as limiting cases of such; for a screw, to be a screw at all, must have a certain lead, be it ever so small, and this lead must be divided into at least two parts, the thread and the groove. If the helix angle be nearly 90 degrees, and be gradually increased up to that angle, it is clear that the lead, and consequently the width and depth of the groove, become microscopic, until, when 90 degrees is reached, they disappear altogether. Similarly, as is shown herein, the maximum axial width of groove (*a*, Fig. 3) which can be cut on any bar to produce a square-thread screw, is equal to half the diameter of the bar. Hence if the helix angle θ be gradually reduced toward zero, the lead of the screw is gradually increased toward infinity, but at the same time the width of the groove normal to the helix *b* becomes steadily less, since its axial width *a* remains constant. Thus we see that as the lead is increased so must the number of threads be increased if the square form is to be retained; when, however, the lead reaches infinity, the angle θ, and consequently the normal width of groove *b* has become zero, and we are left with the plain bar, which shows that a square-thread screw of either zero or infinite lead is an impossibility.

The author of this book then proceeds to the following remarkable statement: "Further, it may be noticed that in order that the shape of both the projection or external screw thread and the space or internal screw thread may be as nearly alike as possible, it is necessary to make the pitch as *small* as possible, for they can only be exactly the same when the pitch is *zero*" (I infer that *lead* is intended), and seeks to demonstrate this by a section (he does not say whether normal or axial), Fig. 4, which depicts an undercut thread working in a parallel groove. Assuming this to be a normal section, it shows the effect produced by cutting both the screw and nut with parallel-sided tools tilted over with the top surface normal to the helix, but it is obviously not *necessary* to follow this incorrect method of cutting screws, the result of which the above ex-

tract states to be unavoidable; further on a method whereby this violent misfit may be avoided will be shown.

The best article on the subject which I have come across is a short appendix in Professor Lineham's "Text Book of Mechanical Engineering," but this is (perhaps necessarily) incomplete, and one illustration, an oblique section of the screw which shows a groove with straight sides converging to the center of the ellipse, is herein shown to be incorrect for square threads.*

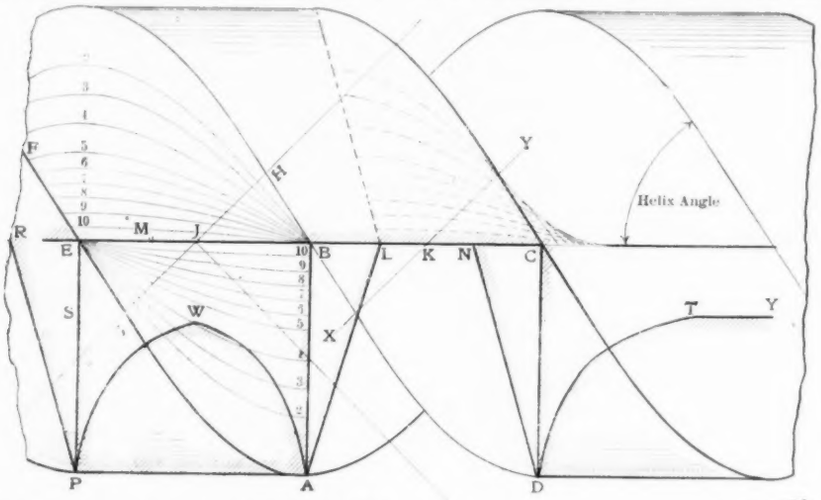
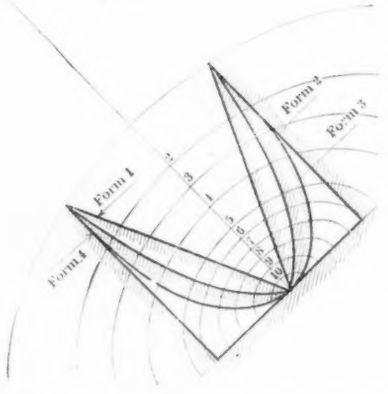


FIG. 5. LIMITING CASE OF A SQUARE THREAD SCREW.

We can now proceed to examine two examples. Fig. 5 shows a portion of a square-thread screw of 4 inches diameter, 8 inches lead, two threads. It will be seen that this is the maximum size square groove which can be cut on a bar of this diameter, inasmuch as it extends right to the center of the bar; but that it *is* a square-thread screw is evident, since it is generated by a square lamina represented in plan by *A B C D*, which may be supposed to rotate around the axis and to be free to move in an axial direction, the point *A* being guided along the helix *A E F*.

Such a screw is never called for in practise (altho we have an approximation of it in the ordinary twist drill); it has no torsional strength, nor could it be cut by a tool of form *A B C D* set with its top surface in position *E B* in elevation, on account of cutting angle and clearance considerations; but this example is here illustrated, as it enables us much more readily to analyze the effects produced by various forms of tool when tilted over with their top surface lying in some plane *G H*.

Taking the square groove first, it is seen that when the cutting edge or generating line *A B* moves from position *A B* to position *E*, point *A* describes a portion of helix *A E* of 8-inch lead, while point *B* describes a straight line *B E* and points intermediate describe portions of helices which are numbered 2—10. The helices for the right-hand side of the groove are shown above the axis, starting from *B*. These show very clearly the decrease in the helix angle *E B H* from 57° 32′ at the circumference to 0° at the center, and, as this angle is constantly decreasing from *A* to *B*, we must select some mean radius between the two to whose helix we will make *G H* normal. The helix selected for this illustration is at a radius of 1.272 inches from the axis and is shown by helix 3, which brings *G H* at an angle of 45 degrees with *E B* for convenience in setting out.



Taking now a section on *G H*, we obtain Form 2, which, it will be noticed, has a curved outline and is the form of tool required to produce a square thread, if tilted over at the angle shown. Next consider the axial form of groove produced by the shaped tool, Form 1. This is shown at *A L N D* and its corresponding thread at *R P A L*. The truth of this is perhaps not apparent at first sight, but is shown from the fact that *G J* is given to be a straight line, and when point *G* has moved to *E*, point *J* has moved along the axis to *M* a distance equal to *G S* and, since the tool is a straight-sided one, all points between *E* and *M* must be on a straight line, which is shown in plan at *A L*, *K L* being equal to *J M* and *G S*. Lastly, we have the rectangular tool of width *G H* shown in Form 4. It is obvious that this tool will cut a core out of the center of the bar, and if one side of the groove only be cut, the thread will be undercut as shown by curve *D Y*, with a short length of straight *T Y*, but when the other side of the groove is cut, interference occurs at point *W*, which increases the diameter of the core cut away and we are left with a *thread* of axial section *A W P*.

It is easy to show that a normal section of a square thread is of the same form as the normal section of its corresponding groove, for since the right-hand side of the groove *A B C D* is generated by the line *C D* and the left-hand side by *A B*, both being parallel and lying in the same axial plane, the two sides of the groove are an exact counterpart of each other; hence a section of thread on *X K* is of exactly the same form as a section of groove on *G J* similarly with the other half of thread and groove, respectively. A little further reflection will show that only in the square thread screw can this be the case, since in no other do the generating lines fulfill these conditions. Form 1 therefore represents a section of groove on *G H* and also a section of thread on *X Y*.

We can now deal with Fig. 6, which is of the same diameter and lead as Fig. 5, but cut with six threads instead of two. Various forms of thread with their corresponding grooves to the right of them, which are produced by tools of Forms 1, 2, 3 and 4 (counting from the inside) are shown. It will be noticed that the projection of the normal sections is reversed from third to first angle for easier comparison with the axial sections. The diameter of helix selected, to which the sections are made normal, is the mean diameter of the thread, 3⅓ inches. This brings the normal section at an angle of 37° 22′ with the axis, a little less than the 45° of Fig. 5.

FIG. 7. FINDING THE FORM OF THE TOOL.

At *A T 2* and *A G 2* are shown the axial sections of square thread and groove, re-

*The author has apparently overlooked the excellent article by Mr. De Leeuw published at page 1160, Vol. 24 of this paper.—Ed.

spectively, and at $NT2$ and $NG2$ their normal sections. These are produced by a tool of Form 2 tilted over at the angle shown. It will be noticed that Form 2 is shown with straight sides; this is not theoretically correct, as is shown by comparison with Form 2 of Fig. 5, but even in this figure the curve approximates a straight line for some distance from the circumference and as in Fig. 6, the form, if continued to the center of the ellipse, is much flatter than in Fig. 5. The approximation is still more close and quite sufficient for ordinary purposes.

$AT1$, $AG1$, $NT1$ and $NG1$ are the sections produced by Form 1, which has a width at the circumference of the ellipse equal to Form 2, but with straight sides converging to the center of the ellipse.

$AT3$, $AG3$, $NT3$ and $NG3$ are produced by Form 3, which is of same extreme width as Form 1, but has parallel sides.

$AT4$, $AG4$, $NT4$ and $NG4$ are given to show the effect of the practise pursued by some turners of forging a tool from round stock, making the cutting edges of width equal to the required groove on axial section, then setting in the tool-post normal to the thread and holding in V-blocks. This produces a thread considerably narrower than its corresponding groove. This is perhaps not always to be condemned, for in the case of a steel screw working in a gun-metal nut the shearing strengths of the materials are in the ratio of about 10 to 3, and in a phosphor-bronze nut about 10 to 6. Thus to obtain maximum strength, the width of thread and groove in the screw should be in the inverse ratios respectively. Moreover, as the nut is usually but a fraction of the length of the screw, its threads, in ordinary construction, are worn out and stripped long before the screw is appreciably affected.

Since an oblique section of a cylinder is an ellipse, and as a screw may be regarded as a cylinder of the diameter at the bottom of the grooves, with the threads planted on it, the tool, when set in the normal position, must have its front hollowed out to the elliptical form shown, otherwise the bottom of the groove will be rounded out to the extent shown in the axial sections. The various axial sections of thread are shown superposed for comparison.

Consider now the cutting of a nut to fit such a screw. In the case of $NT2$, it is obvious that this being a normal section of the screw thread, must also be the normal section of the nut groove that will fit it, but it is necessary, in the case of the nut, to feed the tool from a to b, and if the tool is set normal to the thread, it will of necessity produce a parallel-sided groove in normal section, as shown. The only way to rectify this, without the use of a tap, is to cut the groove of width equal to the screw thread at bottom and then undercut each side separately, a difficult and uncertain job. Otherwise when the screw has worn and torn sufficient material out of the nut, to take a bed across its whole depth, it will have an end slogger, in the case of the present example, of about 3-32 inch, not a very mechanical result.

An inspection of the other sections shows that $NT1$ has sides which are, as nearly as can be drawn, parallel. To obtain their true form we must again refer to Fig. 5. The helices for the truncated thread are here shown and a normal section is taken at $K4$. This is projected over on to the groove sections for comparison, and is shown by Form 3. (Note that this is the form of thread corresponding to groove Form 1.) This approximates very closely to the parallel for some distance from the circumference; hence we may assume $NT1$, Fig. 6, which has a much flatter curve, to be straight for all practical purposes.

Here we have a thread which is probably the best for ordinary purposes, and certainly the easiest to produce with accuracy. It is slightly tapered in axial section, giving a greater shearing area than the truly square with only a very slight bursting stress on the nut and the normal section being, as we have seen, practically parallel sided, it is easy to cut a nut which will be within an ace of a good running fit when the job leaves the lathe.

A more accurate method of obtaining Form 1, Fig. 6, than by drawing is here given.

As is explained in any text book on mechanics, a helix is formed by wrapping a right-angled triangle around a cylinder. The elementary triangle for the example, Fig. 6, is shown in Fig. 7, ABC, in which

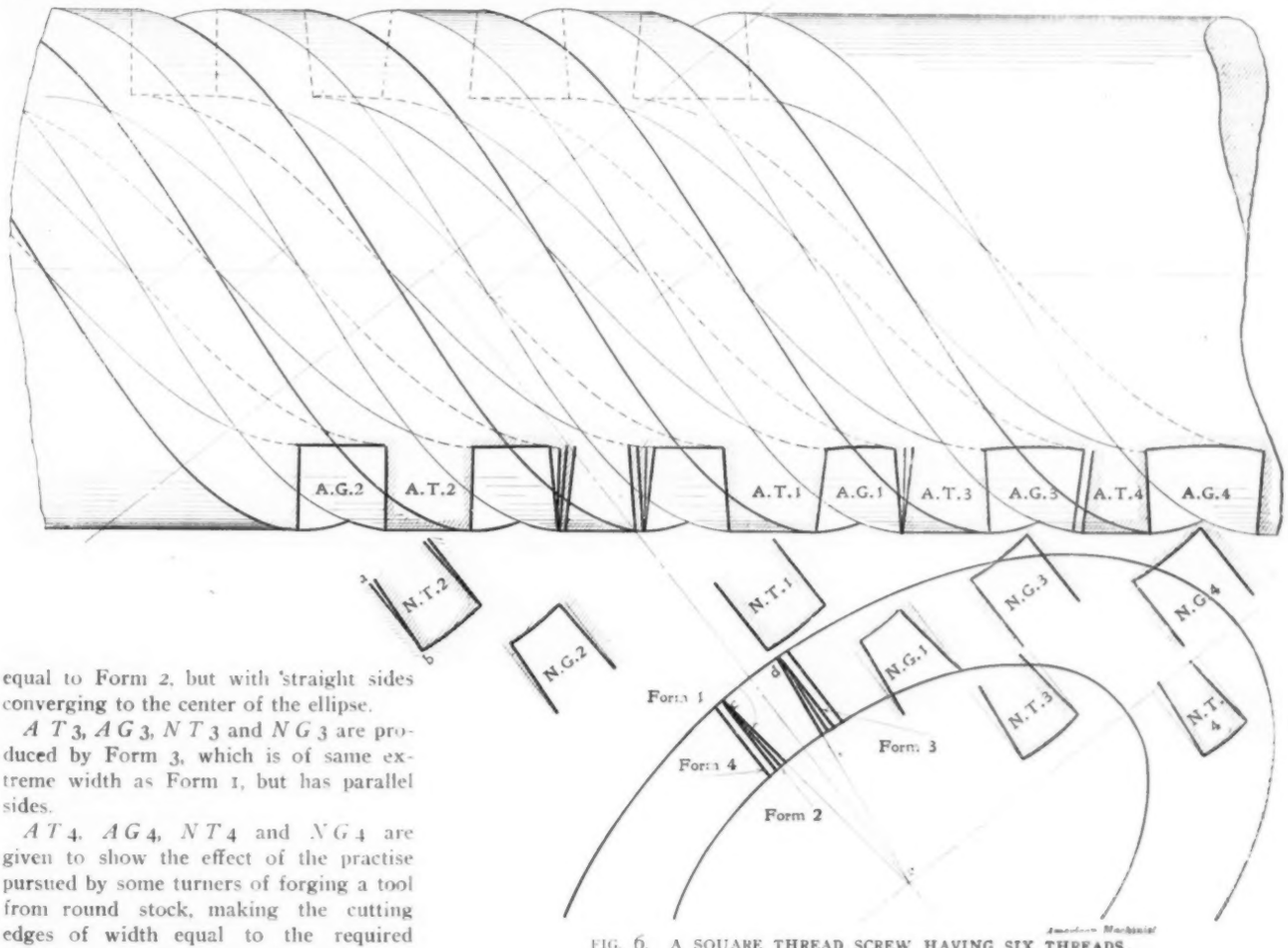


FIG. 6. A SQUARE THREAD SCREW HAVING SIX THREADS.

the lead $A B$ is divided into the six threads and grooves required. Thus each of the divisions on $A D$ is equal to the normal width of the thread or groove *measured along the helix*. This is slightly greater than the chordal width, but the difference is so small that it may be neglected for all ordinary work. Having calculated the length of one of these divisions, it may be taken as the chord of angle *c e d*, Fig. 6, from which the angle itself is obtained. Finally, the point of the tool is hollowed out to approximate the curve of the smaller ellipse.

The tool for the nut is made of Form *N T* 1, with parallel sides of width equal to chord *c d* and the point rounded to approximate the ellipse between *c* and *d*.

In conclusion, this article is not put forth as a complete exposition of the subject, but rather to indicate to those responsible for the production of screws and nuts of low helix angle (and consequently high mechanical efficiency) such as are daily being cut for use in fly presses, screw-driven planers and slotters, etc., how they may be made a commercially perfect fit where the quantities required do not justify the expense of rectifying taps such as are required when screws are produced on the thread milling machine.

Stafford, England.

What is Useless Knowledge?

It is impossible to know what application knowledge may have until after it is acquired, and the seeker after purely *useful* knowledge will fail to acquire any real knowledge whatever. We have here the explanation of the well-known fact that the functions of the investigator of the laws of nature, and of the inventor who applies these laws to utilitarian purposes are rarely united in the same person. If the one conspicuous exception which the past century presents to this rule is not unique we should probably have to go back to Watt to find another. The true man of science of to-day and of all past time has no such expression in his vocabulary as *useful* knowledge. His domain is the whole of nature, and were he to attempt its division into the useful and the useless, he would drop from his high estate.—*Prof. Simon Newcomb.*

Our so-called fireproof buildings when filled with the usual wooden office furniture and other highly and easily combustible material are quite like stoves full of kindling wood, and the movement toward the prevention of disastrous fires will never be completely successful until the stuffing of the buildings is reformed as well as the carcass. Steel furniture is to be installed in all the cruisers and battleships of the United States Navy and the use of such furniture is extending in financial institutions, courthouses, government departments, libraries and business offices, but there is still much more to be done in the same direction.

Industrial Education in Germany—VIII.*

BY UNITED STATES DEPUTY CONSUL MEYER, CHEMNITZ, GERMANY.

SUMMARY.

NATIONAL CHARACTER OF GERMAN EDUCATION.

In Germany education gives prestige. The man of learning is honored and respected, and he moves in the highest circles. The people are marvelously well informed on educational issues and conditions, and are alive to all the important educational problems. They are not permitted to forget the needs of progress and change. Public discussions on educational subjects take place every day. Nor are these superficial or bombastic. The German is fond of details, he loves to get at the bottom of a matter, and so in education he glories in delving deep among the details of the problem. He brings before the public eye a constant stream of educational literature, prepared with great care and presented with inimitable logic and precision. He constructs a type of school which seems best adapted to convey a given quality of education. He formulates its aims in detail and brings the result of his patient research and thought before the bar of public opinion for approval or rejection. Thus it is that German educational progress is national progress. It is the result of national impulse and understanding, and hence embodies both permanence and constant growth.

ORGANIZATION AND NOMENCLATURE OF SCHOOLS.

"In its completeness and carefulness the school system of Germany is such as to excite the foreigner's admiration," said Matthew Arnold in 1886. What would he say to-day? The last thirty years have seen revolutionary changes in the German educational system. The organization of the schools has improved, their co-operation has become more complete. The industrial schools illustrate this quite as well as the general educational institutions, tho, because of their later development, they still lack in slight degree the admirable system and uniformity of the general schools.

The organization of the industrial schools has proceeded on a distinctly scientific basis. The nomenclature is accurate. This is a tremendous advantage in educational reform and a great aid to educational progress. Everybody knows just what is meant when a writer speaks of an industrial continuation school, a "higher" trade school, or a "higher" institute of technology, a commercial "high" school, or when he designates a certain class as the "Tertia," "Ober-sekunda," or "Untersekunda." Every class has its own special name, which is uniform in all the schools, and which determines its relative position in the course of study of the school. Every grade of school likewise has its own name, which at once tells the reader what its general entrance requirements, its curriculum, and its aims must be. The universally established and scientific terminology gives the German educator and critic ready and unmistakable means of expression. He can place his finger on the spot and say: "Here, in my estimation, lies the trouble which we must seek to remove," and everybody will understand just what he refers to. This certainty removes all danger of a waste of energy and time in misunderstood discussions, false criticisms, misapprehensions, and a general useless and wasteful cross-line fire between educational reformers.

PRIVATE INITIATIVE AND STATE AID.

It was quite uniformly true that in the establishment of industrial schools private initiative took the lead. The State generally held back until the private schools had proved their usefulness. Then followed a State subsidy and a general supervisory power, and finally most of the industrial schools of higher rank passed over entirely into the hands of the State. The German deserves great credit for his enterprise and discerning powers in the field of industrial education. Many important trade and commercial schools of to-day were, at the time of their establishment by private individuals, attacked as wild fantasies. Not infrequently State aid was refused, and the individual was compelled to make the best of his own educational views until time vindicated his course. It is not too much to say that to private enterprise probably belongs the greatest credit in the development of Germany's unrivaled system of industrial schools. It was the chambers of commerce, the commercial organizations, the special trade organizations, the guilds, public-spirited benefactors, and men of wide educational discerning powers that contributed most in the construction of the splendid system of industrial schools.

Nor can this reasonably be interpreted as a criticism against the attitude assumed by the State. Records show that this attitude from the first, tho not aggressive, was not hostile or condemning, but highly favorable to the establishment of industrial schools. It was probably great wisdom on the part of the State to avoid criticism at a time when criticism against industrial schools was particularly severe, to hold back and let private enterprise prove the value and efficiency of the schools before extending its own powerful aid and protection. To-day every government in the empire is intensely interested in the welfare of the industrial schools. The time of experimentation as to their value is past. It is now a question of how most economically, most efficiently and most rapidly to further develop these schools. Tho private initiative in the early days broke the way, the State is to-day not delinquent in following out the advantages of early private experience.

The various governments exercise a powerful influence over the organization and work of the industrial schools and the

*Abstracted from Consular Reports.

dispensation of their subsidies. The allowance of a subsidy is generally conditioned upon the meeting of certain requirements in organization, entrance requirements, curriculum and grade of work. Schools which conform to the stipulated requirements enjoy financial aid, while others are assured of like aid as soon as the demands of the State are met. By this means it has been possible to introduce great uniformity into the numerous private institutions. The adopted standards are maintained and enforced by the State thru an efficient system of inspection. Lagging institutions are threatened with the widthdrawal of their subsidies, while efficient work receives recommendation. The public is kept informed of the entrance requirements, work, aims and discipline of the schools thru the systematic publication of complete catalogs. Every industrial school, from the lowest trade school to the technical high schools, annually issues its courses of study, entrance requirements, tuition fees, final examination regulations, disciplinary codes, and all other matter of interest and importance to those who contemplate sending their sons or daughters to a trade school. Where a strict discipline is maintained, and no academic freedom permitted, as in all the lower trade schools, the catalogs invariably contain all the school statutes regulating the conduct of students in attendance. Special notice is given to parents that by sending their son to the school they imply an agreement to abide by the disciplinary code of the institution which, while not oversevere, is generally quite rigorous and keeps the young student within strict bounds of life.

FOREIGN STUDENTS IN GERMAN SCHOOLS.

At different points in these papers statistics have been presented to show how largely students from other countries participate in the industrial instruction of Germany. Some of the technical and commercial high schools are virtually international institutions dispensing knowledge to students of all countries. Out of 519 students who attended the commercial high school of Leipzig in 1902-3, 213 were foreigners (110 of these Russians). Another striking illustration is found in the tanning school of Freiberg, Saxony, where forty-two out of seventy-six students enrolled in 1902-3 were foreigners. In 1903 the ten technical high schools had an enrollment of 2,242 foreigners, out of a total attendance of 14,426.

These hundreds of foreigners return to their various countries and there give no mean aid in the development of industries which are in direct competition with those of Germany. German steel thus meets German steel. German armor, put on in Germany, turns to meet German armor. On the basis of self-protection and national defense the empire cannot be criticized for wishing to close its industrial institutions to the rest of the world. Sentiment in favor of such a move on the part of the Government is reported to be rapidly growing. In some parts the agitation has become a clamor. What results this propaganda may attain in the course of the next few years challenges any attempt at prediction.

The absense of that "spendid isolation" which is the boast of England, and is even more apropos when applied to the United States, is one of the unfortunate hindrances which mar German development. Whatever its advantages, its disadvantages, both political and industrial, are obvious. For all European nations it is but a step into Germany, and once there the student can carry away his fill of the most advanced technical knowledge of the day. That 2,242 foreign technical students can absorb much valuable information requires no calculation to verify. Russia probably profits most in this international educational game. Her students are found in institutions everywhere. Thru personal contact with some of these the writer was surprised to note their broad intelligence, their mental keenness and their linguistic accomplishments. Many of these men speak four or five languages with ease.

MILITARY PRIVILEGE.

One can hardly pick up a German educational treatise without running across the military expression, "Certificate for one year of military service as a volunteer," which, to the uninitiated, is absolutely without meaning as a designation of a certain intellectual attainment. This expression is the key to a most interesting and important relation between the German military and educational system. The certificate, which entitles its possessor to the privilege of but one year of military service instead of two or three, is the most important and most practical measure of intellectual attainment known in Germany. Its value and real merit lie in its definiteness. It represents a certain amount of schooling, a certain mental ripeness, a certain knowledge. Everybody knows just what it represents and uses the expression as he would the name of a coin or a measuring rod. The certificate is granted only after the successful completion of an examination open to all German lads who have finished six years of work in a secondary school. This examination is conducted in the school itself, on the normal and entire course of school work, by a joint examining commission of teachers in the school and government inspectors. The State hence determines this standard of general education, thereby giving it both uniformity and universality.

The possession of this certificate is a great advantage to the German lad. It will be remembered that numerous secondary trade schools require such a certificate for admission to the school. In business also the young man with the certificate is sought, as frequent advertisements demonstrate. The German business man knows exactly what he gets when he advertises "for a boy possessing the certificate for one year of military service as a volunteer." He knows that his boy will have had six years of thorough general education as a foundation for a business career. He need not rely upon generalities in advertising for a "well-educated" young man.

From a military point of view the possession of such a certificate is also of great advantage, in that under the existing military regulations all German youths, as is well known, must perform military service for two or three years, excepting only those who have completed six years of work in some secondary school and have thus become "Freiwilliger," with the privilege of but one year of service as volunteers, and the further great privilege of becoming "lieutenants of the reserves" if, after completing the one year of service with credit, they also pass a military examination.

It is only natural that all parents prefer to have their sons serving as lieutenants in case of war instead of as common soldiers, and the consequence is that all who can afford it, and even many who have to endure privations in order to be able to do so, are sending their sons to higher (secondary) schools so that they may be entitled to serve as "Freiwilliger" and become "Leutnant in der Reserve." This is of great significance from the point of view of industrial efficiency, for the consequence is that many thousands of young men, who, if this institution did not exist, would be sent by their parents to the workshop to earn money, are attending these higher schools. This military regulation exercises a most beneficent influence upon the educational attainments of the German nation, and in a far-reaching manner helps to shape the destiny of the German Empire.

INFLUENCE OF THE GERMAN EMPEROR.

The German Emperor has given his enthusiasm and favor for the development of schools which disseminate a broad and practical knowledge in preparation for the actual needs of ife, as well as offering a cultural education. The Emperor revealed his ideas in a noteworthy speech delivered before the Berlin Conference of Secondary Education, held in 1890, in which he made a plea for the further promotion of the scientific schools, with their broad, practical, modern curriculums, instead of the classical secondary schools with their Greek and Latin.

The same monarch a few years ago issued the watchword, "The future of the German Empire lies on the seas." It had a force similar to Bismarck's famous declaration that "The nation that has the schools has the future." Commerce and industry were the great hope then; and commerce and industry remain the ambition to-day. Education was chosen as the powerful weapon with which to attain this future. To-day this weapon is but just making itself felt. The industrial schools are still young. In the future more

will be heard from the young merchants and manufacturers who daily go out from these institutions. The greatest danger of Germany to the world is probably not in war, but in peace. Her energy is turned to conquests in the industrial world. Her marvelous development is industrial, not political. It is peaceful and spontaneous, and springs from national impulse. Such a development may well be respected and feared. And if we would better arm ourselves against industrial encroachments and equip ourselves for a continuance of our present encouraging commercial expansion with the most effective weapons, we would do well to take the example and lesson of Germany to heart by looking seriously and long to our own industrial schools, good tho they are, and improving and developing these in the light of American conditions and of foreign experience.

A ten-story schoolhouse to accommodate about 8,000 pupils is now talked of in New York. This is not as shocking as it seems, for several five-story schoolhouses now have playgrounds on the roof.

An Electrically Driven, Portable, Radial Drill.

BY DR. ALFRED GRADENWITZ.

The radial drilling machine represented in the accompanying photograph has been constructed by the Elsässische Maschinenbaugesellschaft, of Grafenstaden, Alsatia, with a view to being used mainly in large locomotive and sheet-metal construction shops, where the drilling of holes has to a large extent to be done by hand.

The machine rests on four shoes fitted with leveling screws, and the frame bears a 2.5 horse-power variable-speed motor.

The operation is effected directly by two pairs of bevel gears transmitting to the drill spindle speeds of from 80 to 200 revolutions per minute.

On the prolongation of the motor axle is moved the arm supporting the drill head, both being balanced by a counterweight. The arm is swung by hand with a view to adjusting the drill by a hand wheel and worm gearing. The feed of the spindle is either by hand or automatically.

The machine is fitted with rollers so as to be readily moved about the floor. Its principal dimensions are as follows:

Greatest diameter to be bored with free spindle—35 millimeters (1⅜ inches).

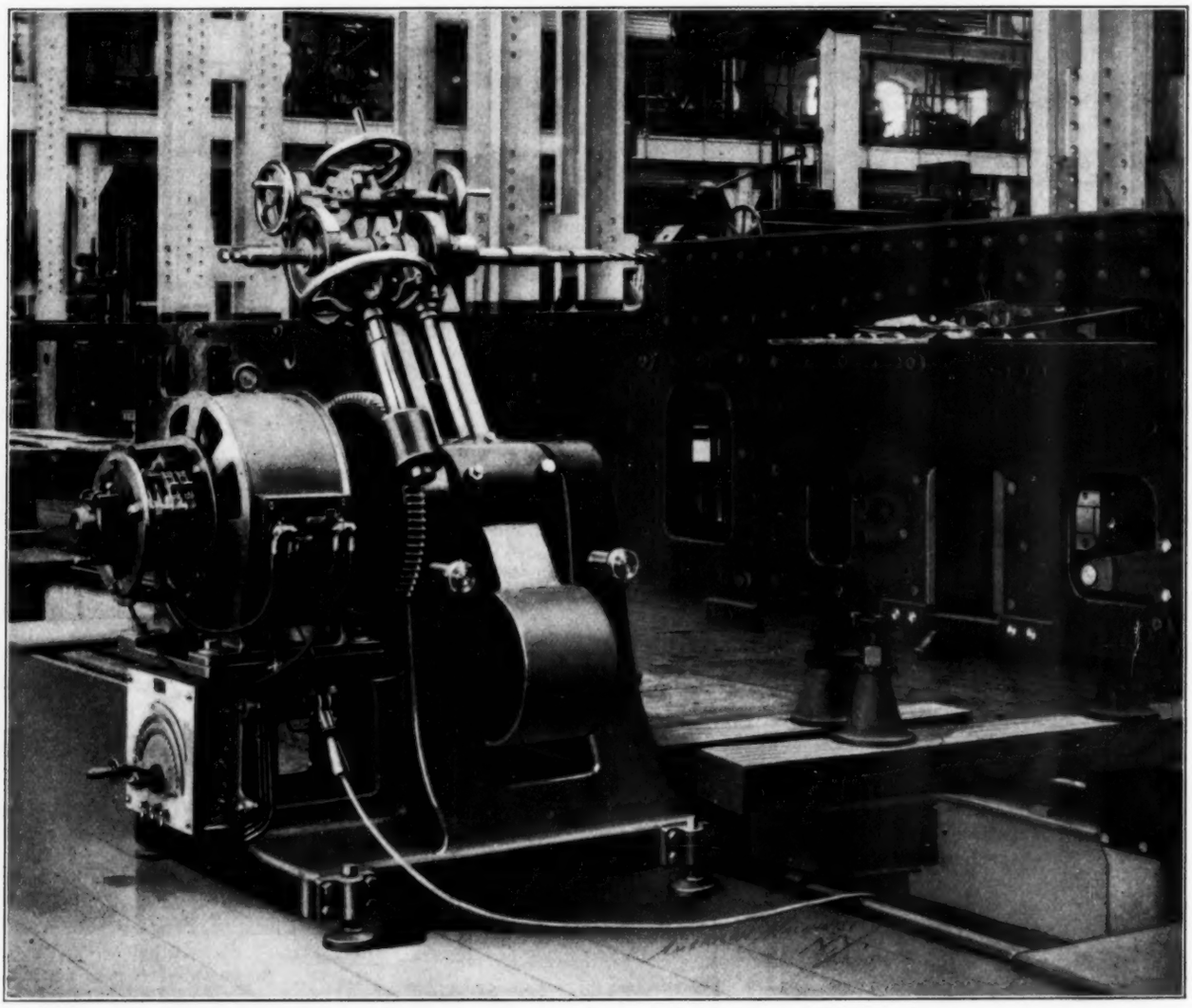
Diameter of boring spindle—45 millimeters (1¾ inches).

Feed of boring spindle—180 millimeters (7 inches).

Distance from floor to axle—895 millimeters (35 inches).

Greatest distance from the drill to axis of rotation—830 millimeters (32.5 inches).

Smallest distance from the drill to axis of rotation—370 millimeters (15 inches).



ELECTRICALLY DRIVEN PORTABLE RADIAL DRILL.

Approximate weight—1,950 kilograms (4,300 pounds).

Berlin, Germany.

The German Society of Mechanical Engineers offers a prize of 6,000 marks for a treatise on locomotive construction embracing the theoretical discussion of its fundamental principles. Its announcement says that in spite of the many treatises on the locomotive, there is still lacking an exhaustive theoretical discussion of the thermal, mechanical and geometrical principles involved, such as may serve as a guide in designing engines for special purposes.—*The Engineer.*

Balancing a Valve and Diafram.

BY JAS. CLARK.

Recently I was called upon to give the outside diameter of a diafram to balance a valve of 1¼ inches diameter of seat, both connected to the same stem, which was ½ inch diameter, as shown in Fig. 1. As I could not find any data on the above condition in any books I had at hand, I send in my solution of the problem, hoping it may be of some use to some of the readers of the AMERICAN MACHINIST. See Fig. 2 in reference to the following analysis:

Let x be the radius of any circle lying between radii R and a, then $2\pi x$ equals the circumference of this circle, of which bc is a very short arc. If we call bc $\frac{1}{n}$ of the circle, then $\frac{2\pi x}{n} = bc$. Consider a strip dx in width and $\frac{2\pi x}{n}$ in length, of which the area is $\frac{2\pi x\,dx}{n}$, and the integral of this expression between the limits of R and a will give us the formula for the area of the frustrum of the sector $dfgh$.

$$\int_a^R \frac{2\pi x\,dx}{n} = \frac{2\pi}{n}\int_a^R x\,dx$$

$$= \frac{2\pi x^2}{2n}$$

$$= \frac{\pi x^2}{n}$$

Introducing the limits, we have $\frac{\pi(R^2-a^2)}{n}$ and multiplying by n we have $\pi(R^2-a^2)$, the formula for the area of a complete ring and, making $a = o$, we have πR^2, the formula for the area of a circle. These are well known and show the expression to be correct.

If we now multiply $\frac{2\pi x\,dx}{n}$ by $(R-x)$ we will have the area moment of the elementary strip about dh as an axis and the integral of $\frac{2\pi x\,dx}{n}(R-x)$ between the limits R and a will give the total area moment of the frustrum of the sector $dfgh$ about dh as an axis.:

$$\int_a^R \frac{2\pi(R-x)x\,dx}{n}$$

$$= \frac{2\pi}{n}\int_a^R (R-x)x\,dx$$

$$= \frac{2\pi}{n}\int_a^R Rx\,dx - \frac{2\pi}{n}\int_a^R x^2\,dx$$

$$= \frac{2\pi R x^2}{2n} - \frac{2\pi x^3}{3n}$$

$$= \frac{3\pi R x^2 - 2\pi x^3}{3n}$$

Introducing limits, this becomes:

$$\frac{3\pi R(R^2-a^2) - 2\pi(R^3-a^3)}{3n} \quad (4)$$

$$= \frac{\pi(R^3 - 3Ra^2 + 2a^3)}{3n} \quad (5)$$

which is the total area moment of the frustrum about dh as an axis. Considering dh as a very short arc of the circle, which is obtained by making n very large, dh may also be considered a straight line. If in (5) a be made equal to zero, it becomes $\frac{\pi R^3}{3n}$.

The area moment of a triangle about its base is equal to the product of its area into the distance of the center of gravity from its base—that is,

$$\frac{bh}{2} \times \frac{h}{3} = \frac{bh^2}{6}$$

in which b = the base
and h = the altitude,

and it is easy to show that $\frac{\pi R^3}{3n}$ is equal to $\frac{bh^2}{6}$ thus: Since $\frac{2\pi R}{n}$ is equal to the base dh of the triangle doh and R is the altitude,

$$\frac{2\pi R}{n} \times \frac{R}{2} = \frac{\pi R^2}{n}$$

is the area of the triangle and

$$\frac{\pi R^2}{n} \times \frac{R}{3} = \frac{\pi R^3}{3n}$$

is the area moment of the triangle about its base, which tends to prove the correctness of (5).

If we divide (4) by $(R-a)$ we have the amount of the area of the frustrum which is supported at P_1:

$$\frac{3\pi R(R^2-a^2) - 2\pi(R^3-a^3)}{3n(R-a)}$$

$$= \frac{\pi(R^2 + Ra - 2a^2)}{3n} \quad (6)$$

By making $a = o$ this becomes $\frac{\pi R^2}{3n}$ which is ⅓ the area, which again is known to be correct.

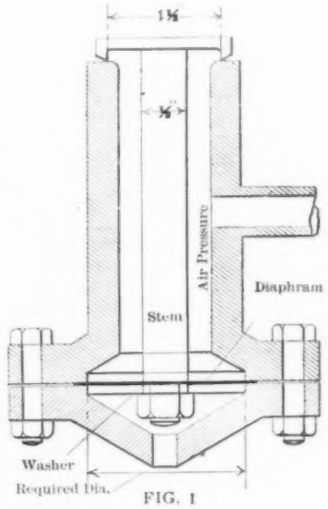


FIG. 1

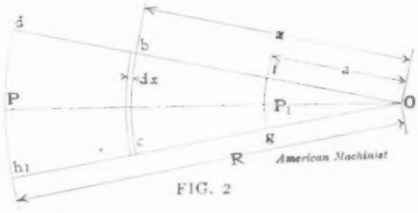


FIG. 2

Multiply (6) by n, as there are n frustrums in the complete circle, and we obtain:

$$\frac{\pi}{3}(R^2 + Ra - 2a^2) \quad (7)$$

as the general formula for the amount of area carried by a stem of radius a. The radius of our valve is ⅝ inch and of our stem ¼ inch, giving the area which is to be balanced by the diafram as

$$\pi\left[\left(\frac{5}{8}\right)^2 - \left(\frac{1}{4}\right)^2\right] = \pi\frac{21}{64}$$

Equating this with the area of the diafram supported by the stem, we have:

$$\frac{\pi}{3}(R^2 + Ra - 2a^2) = \pi\frac{21}{64}$$

or

$$R^2 + Ra - 2a^2 = \frac{63}{64}$$

Substituting the value of a, this becomes:

$$R^2 + \frac{R}{4} = \frac{71}{64}$$

from which

$$R = -\frac{1}{8} \pm \sqrt{\frac{71}{64} + \left(\frac{1}{8}\right)^2}$$

$$= .935 \text{ or } -1.185.$$

The positive value being the one we want, we have:
Diameter of diafram $= 2R = 1.87$ inches.

The West Side Young Men's Christian Association, of New York city, which has a magnificent new building that it claims to be the best in the United States, is rapidly developing into a large evening technical school. In pursuance of its policy of extending opportunities for the education of young men, it has decided to offer a course in advanced machine design which will be beyond anything that has heretofore been attempted in an evening school. The aim of the course will be to teach actual designing in such a way that any man who completes the course will be able to do more than merely copy what someone else has done. He will be actually able to design. Men who enter this course must therefore be already able to draw and must have some readiness at computation. The course will be under the direction of Prof. Amasa Trowbridge, of Columbia University, who is also a member of the American Socity of Mechanical Engineers and has wide experience as a designing and constructing engineer.

Calico printing with copper rollers is increasing in Germany, there being now in use there about 450 machines each having from 100 to 300 rollers. Each roller will bear returning about twenty times: but about 5,000 new ones costing about $30 each are called for every year. Many are imported from England, for the English rollers are conceded to be the best, and English taste in patterns still rules in the markets of the world. Vogts, of Neiderbruck, and Heckmans, of Duisberg, make the rollers in Germany

What a Circular Saw Can Do.

The samples of sawing shown in the half-tones are reproduced for their intrinsic interest to the general mechanic and require no explanation. We are assured that every piece shown was cut entirely by a circular saw or on a saw table, and the surfaces are all shown precisely as the saw left them. Some of the samples may be regarded as mere mechanical curiosities, and yet in the variety of work that comes to the patternmaker, the cabinet maker, the model maker and others, nearly every operation indicated may be at some time useful and to many they must be suggestive of new possibilities. Some of the more difficult manipulations involved have been described from time to time in our columns. The method of sawing the screw, for instance, was described in our columns a couple of years ago. The screw here shown (Fig. 2) was 3½ inches diameter and 1¼ inches pitch. The panel at the right in Fig. 1 shows a sample of work done with an adjustable dado or grooving head. Any width of cut up to 2 inches can be made at any angle or depth, either with or across the grain of the wood. In the next panel to the left the sawed carved grooves are worthy of notice, as also the shapes of the picture frame molding in the middle panel. The surfaces shown in the first panel at the left may of course be reproduced to any extent of surface, as desired. The samples shown were all sawed upon a universal saw table, made by the Colburn Machine Tool Company, Franklin, Pa., which has been previously described and illustrated in our columns.

FIG. 1. SAMPLES OF CIRCULAR SAW WORK.

Alcohol for Motors—III.

BY M. C. KRARUP.

Trying to get a little closer yet to the question of how much power can be gotten out of a motor fed with alcohol vapor compared with a motor of the same dimensions fed with gasoline, we find some other interesting figures. Sorel states the theoretical amount of air required for burning 1 kilogram of denatured 90-degree alcohol is 6 cubic meters, and for 1 kilogram of *essence* or gasoline 11.850 cubic meters. But if good combustion shall be secured under all conditions, the theoretical amount of air, he finds, must be multiplied with 1.3 to 1.7 (the variation depending mainly on temperature). I have no exact figures for the space occupied by 1 kilogram of denatured alcohol vapor or the space occupied by 1 kilogram of gasoline vapor; but taking, by way of approximation, the figures used above for pure alcohol and benzine, and multiplying the theoretical air requirement in both cases with 1.5, we find that the explosive and thoroughly combustible mixture formed from 1 kilogram of 90-degree denatured alcohol occupies:

$$0.485 + 9 = 9.485 \text{ cubic meters,}$$

containing 5,923 calories, while the explosive and thoroughly combustible mixture formed from 1 kilogram of gasoline occupies:

$$0.286 + 17.775 = 18.061 \text{ cubic meters,}$$

containing about 10,500 calories.

Again reducing to equality of volume:

$$\frac{18.061 \text{ cubic meters}}{10{,}500 \text{ calories}} = \frac{9.485 \text{ cubic meters}}{x};$$

giving $x = 5{,}514$ calories,

or, a thoroughly combustible gasoline vapor mixture contains 5,514 calories, as against 5,923 calories in an equal volume of thoroughly combustible 90-degree denatured alcohol vapor mixture.

While these rather surprising figures are subject to whatever minor amendment may arise from exact knowledge of the specific gravity of the two vapors under consideration, I have ventured to lay some stress on the high caloric value of each explosive charge derived from alcohol, because I find it nowhere else referred to, and because

1. It explains why automobile motors, designed mainly for gasoline, may be operated with alcohol without sensible power reduction, by sacrifice of fuel economy, and

2. It promises that automobile motors, if designed specially for alcohol, so as to get the benefit of the high thermic efficiency accomplished in stationary alcohol motors, will be more compact, for any given power, than our present gasoline motors, and

3. The dynamic efficiency of an alcohol motor is of special importance in a country like the United States, where abundance

of cheap, rich lands renders it probable that alcohol may be produced so cheaply—once the tax is removed—as to take the edge off the question of economical efficiency in favor of other considerations.

It seems worth noting in the figures pertaining to this matter that the volume of air required for the combustion of 90-degree alcohol vapor is less, according to Sorel, than for the combustion of the vapor from absolute alcohol, and that the minimum proportion of 10 air to 1 vapor arrived at by Périssé and Valette are in accordance therewith, so that we may infer that the 10 per cent. of water actually assists in securing combustion, when other conditions are right, besides serving the purpose of permitting higher compression and a higher thermic efficiency, as further detailed hereafter.

With regard to gasoline, on the other hand, if the range for air admixture by which perfect combustion may be secured should prove as narrow as suggested by Périssé and Valette's figures for benzol-alcohol (1-41 to 1-52) and Sorel's figure—1.3 to 1.7 times the theoretical volume of air—should not be admissible, this would in practise mean only that a gasoline vapor mixture would usually lose by partial non-combustion what it gained in number of calories for a given cylinder volume.

Especially in automobile practise, where high operative skill cannot be the rule, the wide variation of the amount of air admixture admissible with alcohol as fuel, should mean a gain in the economical as well as in the dynamic efficiency of a motor.

We now pass to the question of thermic efficiency, or the determination of how well the alcohol motor utilizes the calories fed to it, transforming them into mechanical work.

As early as 1894, Prof. W. Hartmann reported to the German Agricultural Society that a stationary petroleum motor operated with alcohol gave excellent power results but used far too much alcohol. Dynamically, the fuel was a great success, economically a flat failure. Special regulation of compression, ignition and carburation in conjunction with lower alcohol and higher petroleum prices have changed the latter half of this verdict; the special regulations bringing about an increased utilization of the calories, offsetting the larger amount of the liquid fuel used for each explosion (as compared with gasoline in a motor of similar dimensions).

(Supposing the number of calories to be even for the two fuels in each charge, we should find greater power in the alcohol, motor dimensions and revolutions per minute being equal. An examination of the test tables in this respect would be interesting, but the data at hand do not permit it.)

An account of what becomes of the calories introduced in the gasoline motor shows strikingly how readily we should be willing to expect more thermic efficiency from another fuel. In the French tests of 1902 its thermic efficiency frequently did not exceed 14 per cent., ranging from this to 20 per cent., and in a few rare cases touching 25 per cent., and this under test conditions.

From another source I take the following estimate:

In the internal-combustion motor of the accepted type [for automobiles] the utilization of the calorific energy varies from 15 to 20 per cent.

Representing the number of calories which are liberated by compiete combustion by 100, we have:

Calories wasted in the exhaust....	27
Calories lost by radiation or otherwise.....	9
Calories carried away by cooling water.....	48
Leaving at disposal for work.....	16
	100

At the comparative tests held in Berlin in 1902 and reported by Prof. Dr. E. von Mayer, the highest thermic efficiency obtained for benzine motors was 20.6 and for kerosene 18 per cent. Similar trials were conducted in 1903 for the Austrian Minister of Commerce by L. Erhard with two 8 horse-power motors and gave 16.5 per cent. caloric efficiency for benzine and 28 per cent. for 90-degree alcohol.

From two special types of petroleum engines better efficiencies are obtained, however. The Banki motor, made by Ganz &

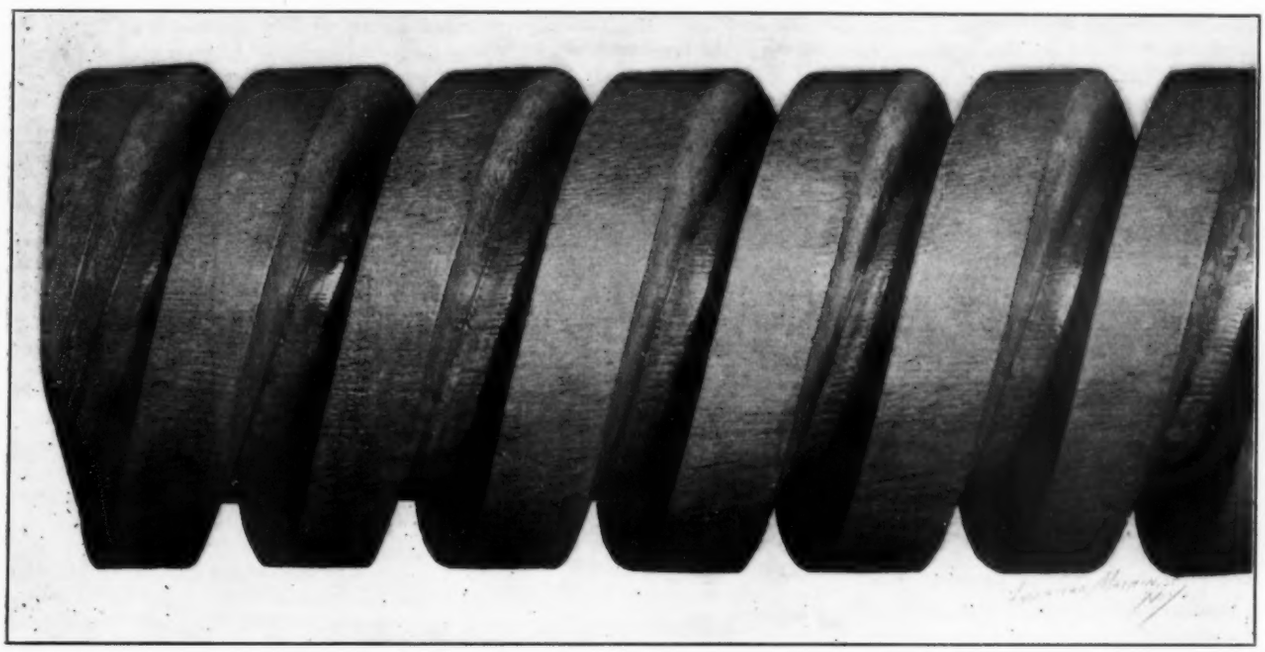


FIG. 2. A SCREW CUT ENTIRELY BY A CIRCULAR SAW.

Co., of Buda-Pesth, when exhibited at Vincennes in 1900, gave a 28-per-cent. thermic efficiency, obtained by the injection of 2.205 pounds of atomized water per horse-power-hour, the injection being made during the compression stroke. The compression was 234.2 pounds per square inch. The Diesel motor with its enormous compressions (above 700 pounds per square inch) and liquid fuel injection commencing at the end of the compression stroke, has given still higher percentages in various tests. But while these results may show the way toward increased economy with petroleum fuels for certain forms of work where neither the complication of water injection or massive design is objectionable, the comparison for alcohol motors must of course be made with petroleum or benzine motors of the designs accepted for general purposes in the power market. The crux of the comparison is indeed as

much to ascertain in what manner the special properties of alcohol lend themselves to ready and convenient utilization for power purposes, as to determine the exact economical relations.

Of ten alcohol tractor engines entered for a prize competition in the Berlin trials (1902), one gave a thermic efficiency of 32.7 per cent. and two others above 30 per cent., all with German denatured alcohol. At the French trials the same year the results with denatured alcohol (containing 8.55 per cent. wood alcohol) were not uniformly so good, but Gustave Chauveau reports one case where it was even better, reaching 38 per cent., being considerably higher for the 90-degree alcohol than for carburetted (50 per cent. benzol) mixture in the same motor, which was a 16 horse-power Brouhot running at 180 revolutions per minute. Chauveau calls attention to the fact that there really were no "alcohol motors" at these trials, but only gasoline motors regulated to burn alcohol. Their dimensions, as given in the tables, are therefore of small value; but it was observed that the conditions which produced the most economical results were high compression, long stroke and small number of revolutions per minute. Complication with other varying features of construction prevented all definite conclusions, however, on these points, except that 140 pounds per square inch was a safe compression for 90-degree alcohol. Under half load the efficiency always fell to much lower figures, in about the same proportions as with gasoline, and generally lower than in the German trials, it seems, altho hit-and-miss governing was until then commonly employed in French stationary motors, and should give a higher fuel economy than the throttling system now used almost exclusively in the German stationary tractor alcohol engines.

Reverting to the German trials, we find that the three prize winners in the tractor engine competition consumed alcohol per horse-power-hour as shown in Table 1:

	Full Load, Grams Alcohol.	Normal Load, Grams Alcohol.
The Deutz engine	365	389
The Marienfelde	352	397
The Dürr . . .	384	412

TABLE 1. RESULTS OF GERMAN TRIALS OF ALCOHOL MOTORS.

This is mainly of interest as showing a considerable variation in the decrease of efficiency as the load is reduced, the Dürr showing the smallest loss, probably by reason of smaller frictional wastes in its operation. In the Deutz engine no carburettor is used and the spray of alcohol is drawn into the cylinder only during the last half of the suction stroke, apparently on the original Otto theory of stratification, but possibly to avoid "splitting" of the alcohol resulting in formic aldehyde and soot deposit in the motor. The consumption of the Deutz engine corresponds to a thermic efficiency of about 32 per cent. The same firm makes benzine and kerosene engines and all these three types gave in a comparative test the results shown in Table 2.

With small motors of about ¾ horse-power and 600 revolutions per minute, the consumption was found to run up to 750 grams per horse-power-hour at full load. At the time of these trials little had been done to adapt automobile motors to alcohol, and the data in regard to them are therefore not at all conclusive, but it may perhaps be assumed that their efficiency would lie between that of the small ¾ horse-power and that of the slow-speed tractor engines of about 10 horse-power referred to in the above figures.

Professor Meyer calculates that at a price of 20 marks per 100 kilograms alcohol (90-degree denatured), 24 marks for benzine and 22 marks for kerosene, the economy of the three fuels would be about equal, while at present the benzine motor shows a slight superiority under full load (7.1 money units for benzine to 7.3 for alcohol), in spite of the higher thermic efficiency of the alcohol, 1,000 calories derived from alcohol costing 3.64 pfennigs, as against 2.33 pfennigs for 1,000 benzine calories and 2.14 pfennigs for 1,000 kerosene calories.

Accepting the proportion in these figures we infer that in America the price of 15 cents per gallon of 90-degree alcohol would place this fuel economically on par with gasoline at 18 cents per gallon, for stationary and slow-speed portable motors, the latter including most marine motors, while the question of economy for automobile motors would still remain in abeyance, pending further developments. From 180 to 250 revolutions per minute is, as near as I can find, the highest motor speeds in the alcohol motors for which high thermic and economical efficiency was recorded.

At the congress convened in Paris, 1903, to record the data and desiderata in regard to the industrial applications for alcohol 1,500 members were present, and they resolved that 90-degree alcohol must be sold for 25 centimes per liter (about 20 cents per gallon) before it would be competitive with *essence de petrole*, or high-grade gasoline, but Mr. Chauveau calculates that at 25 centimes for 90-degree denatured alcohol and 35 centimes for benzol-alcohol per liter, both these fuels would have an economical superiority over gasoline at 50 centimes (40 cents per gallon) in the relation of 350 to 140 and over kerosene at 40 centimes in the relation of 350 to 200. Chauveau bases these figures, however, on the thermic efficiency of 38 per cent. for the best stationary slow-speed alcohol motor.

The present price of 38 cents per gallon for 90-degree denatured alcohol in France compared with the German price of 15 to 18 cents per gallon makes it very clear why the alcohol movement in Germany has assumed great practical importance, while in France it has won only an academic success, altho also petroleum products are much higher there than in Germany. That America should be able to produce alcohol cheaper than Germany goes almost without saying, and on this assumption—of which more later—it may then be said that the alcohol movement has already reached the stage where it is possible to state with certainty that the removal of the tax from the alcohol production would prevent all further increase in the price of gasoline and kerosene as fuels for slow-speed motors, with a large margin of probability that a little aggressive technical development would extend the truth of the statement to automobile and other high-speed motors as well.

	ALCOHOL.		BENZINE.		KEROSENE.	
	Grams consumed per H.P. Hour.	Cost, pfennig.	Grams consumed per H.P. Hour.	Cost, pfennig.	Grams consumed per H.P. Hour.	Cost, pfennig.
Full Load	365	7.3 to 7.6	297	7.1	330	7.3
Half Load	507	10.1 to 10.6	434	10 4	492	10.8

TABLE 2. RESULTS OF GERMAN TRIALS OF ALCOHOL AND PETROLEUM MOTORS.

A new file cutting machine, invented by a German, has been taken up by several firms in Sheffield. The chief characteristic of the machine is that it will cut half-round blanks, as well as flat ones, and is adaptable for cutting any length and shape of rasp. The blank is firmly secured, half-round side upward, to a rocking bed, which brings every successive punching line to the same distance below the chisel. There are ingenious devices for waving each line of punches, for lightening the blow as it approaches the tapered end of the blank, and for putting the lines of punches in echelon transversely across the face of the blank, as well as undulating them longitudinally. In this way the desired irregularity is secured on the rasp, and when used on wood, leather, or soft metal, it leaves no straight lines. Coarse horse rasps are punched 300 punches a minute, fine rasps at 600. The machine requires little power. —*The Engineer*, London.

Forty per cent. of the coal in a mine is left there to support the roof, and a hundred years of thinking has not found a way to get it out.

Letters From Practical Men.

A Job of Loam Molding.

Editor American Machinist:

I show in half plan and sectional elevation on the left of Fig. 1 a gray-iron brake ring, 7 feet 1 inch in diameter on the tread, made in halves and parting at *a*.

The gray-iron pattern ring shown in Fig. 2 was first made, 1¼ inches smaller in diameter than that of the tread. The centering lugs 1, 2, 3, 4, Fig. 2, with core-prints for bolt holes are cast in one piece, with double shrinkage allowed. This iron pattern was employed here in preference to a wooden pattern, as it would be unaffected by the heat during the drying of the mold.

The gray-iron loam plate 1, Fig. 1, is fixed on the foundry oven truck or any other convenient position and the center spindle *a*, Fig. 2, is placed in the usual manner in its socket previously fixed on the truck. The gray-iron pattern ring, Fig. 2, is now fixed concentric with the spindle on a bed of loam already prepared, located by shoulder *b*, Fig. 3, on board 1, proceeding along the usual lines for this class of work to joint *b*, Fig. 1. After this is finished striking board 1, Fig. 3, is removed, and this part of the work is now ready to be placed in the foundry oven to be dried.

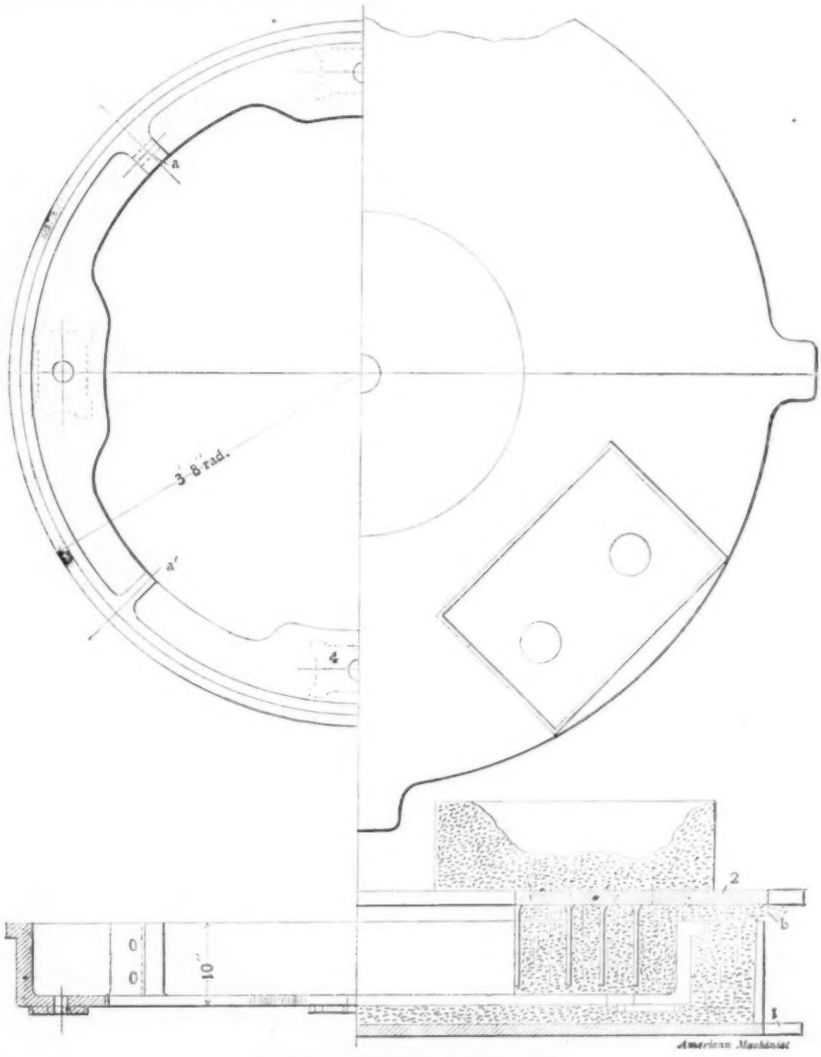


FIG. 1. MOLDING A BRAKE RING.

Plate 2, Fig. 1, is now dealt with in the same manner as plate 1, striking board 2, Fig. 3, being now used, first with temporary piece *c*, Fig. 3, screwed on as shown in dotted lines. By this method a true bed is obtained on which flange patterns *d*, Fig. 3, and brackets *a'*, Fig. 1, are fixed in position. Board *c* is now taken off, and we proceed in the same manner as already referred to, until joint *b* is reached. Board 2 is now taken away and this part is placed in the oven. When dry, the gray-iron ring pattern is withdrawn, also the flange and bracket patterns, and parting or cutting plates *e*, Fig. 3, with bolt hole cores are fixed in their respective prints, when the mold is tooled, blackened, etc., in the usual way. All that remains now to be done is to carefully put the parts together, secure them and provide runners and risers as shown.

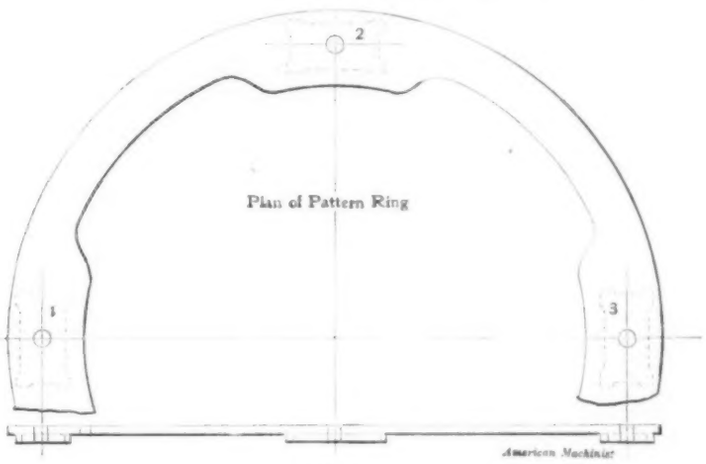


FIG. 2.

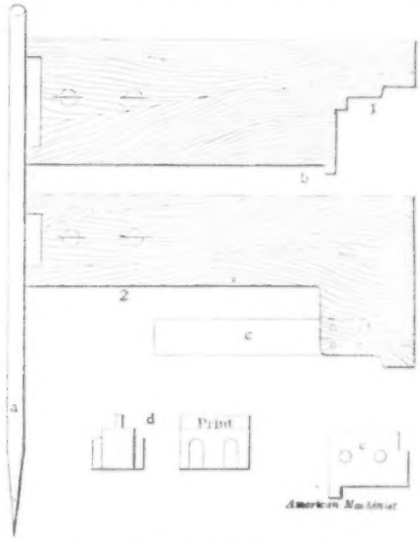


FIG. 3. SWEEPS FOR BRAKE RING.

ROBERT JONES.

Brymbo, N. Wales.

Hardening Drill-Jig Bushings.

Editor American Machinist:

How to harden drill-jig and reamer bushings to prevent shrinkage: Heat the bushing evenly in a slow fire to a fair hardening temperature, withdraw from fire and rub or sprinkle cyanide of potassium all over the piece, reheat as before and then plunge it into a bath of warm oil, and do not withdraw until the piece has reached

the same temperature as the oil. The bushing will be hard, and does not require drawing, owing to its great toughness. Rub all over with a file card or stiff wire brush to clean the piece. After a close examination, the operator will find the bushing has not changed its shape or size, as would surely be the case were it hardened in water. Care should be taken to catch the piece with a very small pair of tongs around the outside. A poker should never be placed thru the hole while dipping. This is a very simple operation, and one that should be practised in every factory where jigs are made, yet, how many mechanics are, even to-day, wasting valuable time lapping jig bushings after they are hardened! Just a little shop leak, but easily remedied. JOSEPH W. BENNETT.

A Milling Machine Vise.

Editor American Machinist:

I enclose a blueprint of a milling machine vise which I think will interest some of the readers of the AMERICAN MACHINIST, especially those engaged in the manufacture of fine light machinery, such as typewriters, cash registers, etc., in which thin, flat steel is used. Some of the parts are finished to tests, and by locating them on the vise-jaws by pilot pins, guide plates, etc., the milling operation can be rapidly and accurately performed.

The vise is comparatively simple in construction and does not cost much to built. The jaws are removable, it being found to be better to have a set of jaws for each piece. The back jaw is made adjustable, to allow for different thicknesses of stock.

H. S. GLADFELTER.

Chuck for Small Dies.—A Die Dividing Attachment.

Editor American Machinist:

Most of our work is finished on dial presses. Each plate contains sixteen hardened bushings similar to the one shown in Fig. 1. Each set of bushings is of a different hight, and size of hole. As new sets are constantly being made or old ones repaired or worked over, it became necessary to design some special chuck to hold them tight and true without any adjusting. So the chuck shown in Fig. 1 was made which gives excellent service. *A* is a casting bored to fit the split collet *B*. *B* is bored to fit the bushings and is drawn in so as to hold them by the threaded ring *C*, which fits the thread on *B* at the back. *D* is a key or feather to prevent *B* from turning. *E* is an opening thru which to operate ring *C*. When *B* is drawn in sufficiently to hold a bushing, by using the same *F* hole all the time there is enough opening in the space *E* to loosen and tighten *B*. A rod about 8 inches long was used to tighten the chuck. The clearance holes for the bolts in the face-plate are left a little large, because in changing around on the different lathes there might be a little variation in the spindles, and this would allow for any adjustment if necessary.

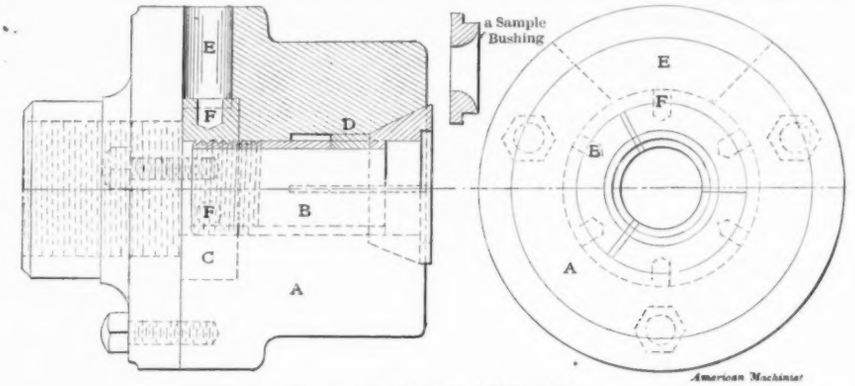
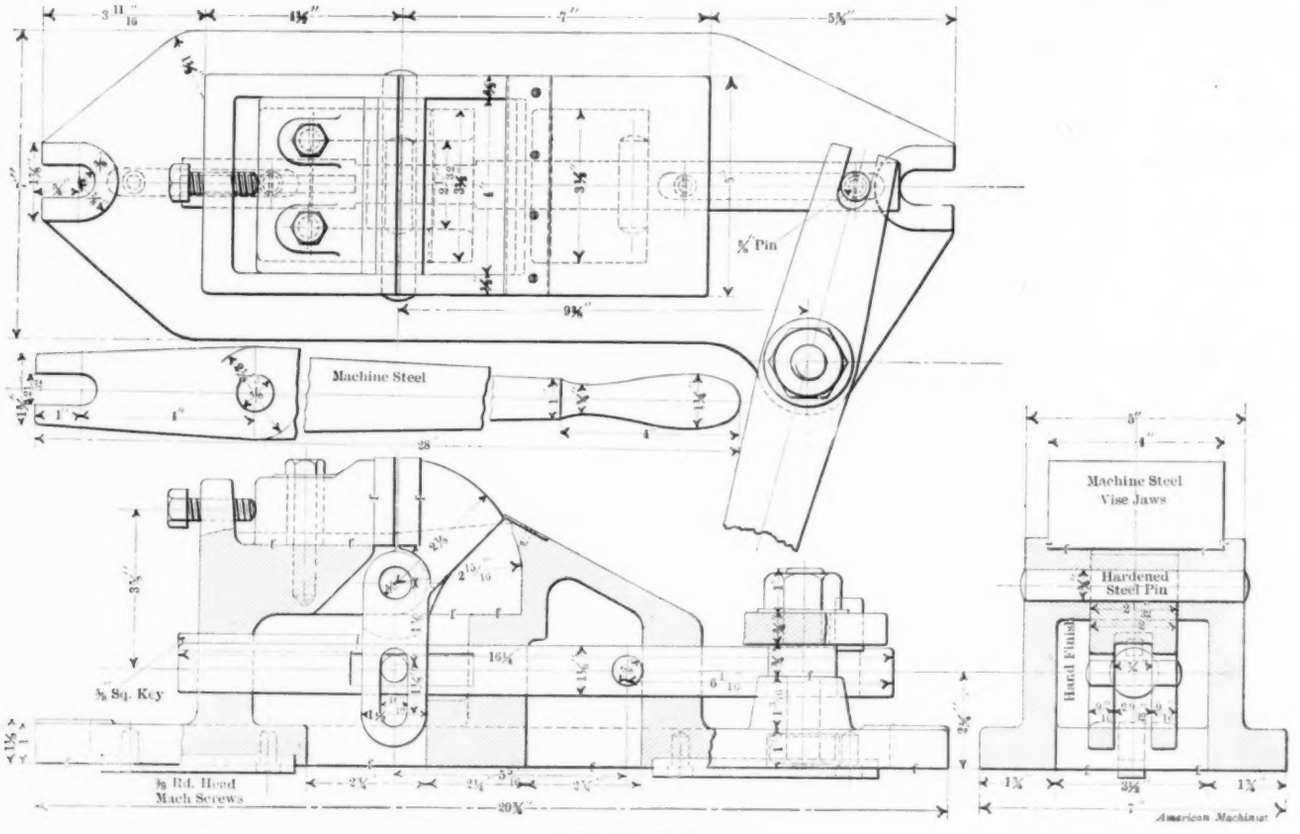


FIG. 1. CHUCK FOR SMALL DIES.



MILLING MACHINE VISE.

Fig. 2 shows a useful attachment used in connection with the die shown. In making a die like this, it is first roughed out thru the different slots and is then finished, as far as size is concerned, in this attach-

ment. *A* is a bolster plate. *B* is a spare gear with 60 teeth, taken from one of the lathes. *C* is the part which receives the die. This passes down thru the gear, and holds it in place. It then goes down thru the bolster plate, and is held by the collar *D*. *E* is a steel bar which is a sliding fit in *C*. This attachment in use was bolted on a foot press, or any press that was handy, so long as it had a hole for the bottom of it to pass thru. After the die is roughed out somewhere near size it is

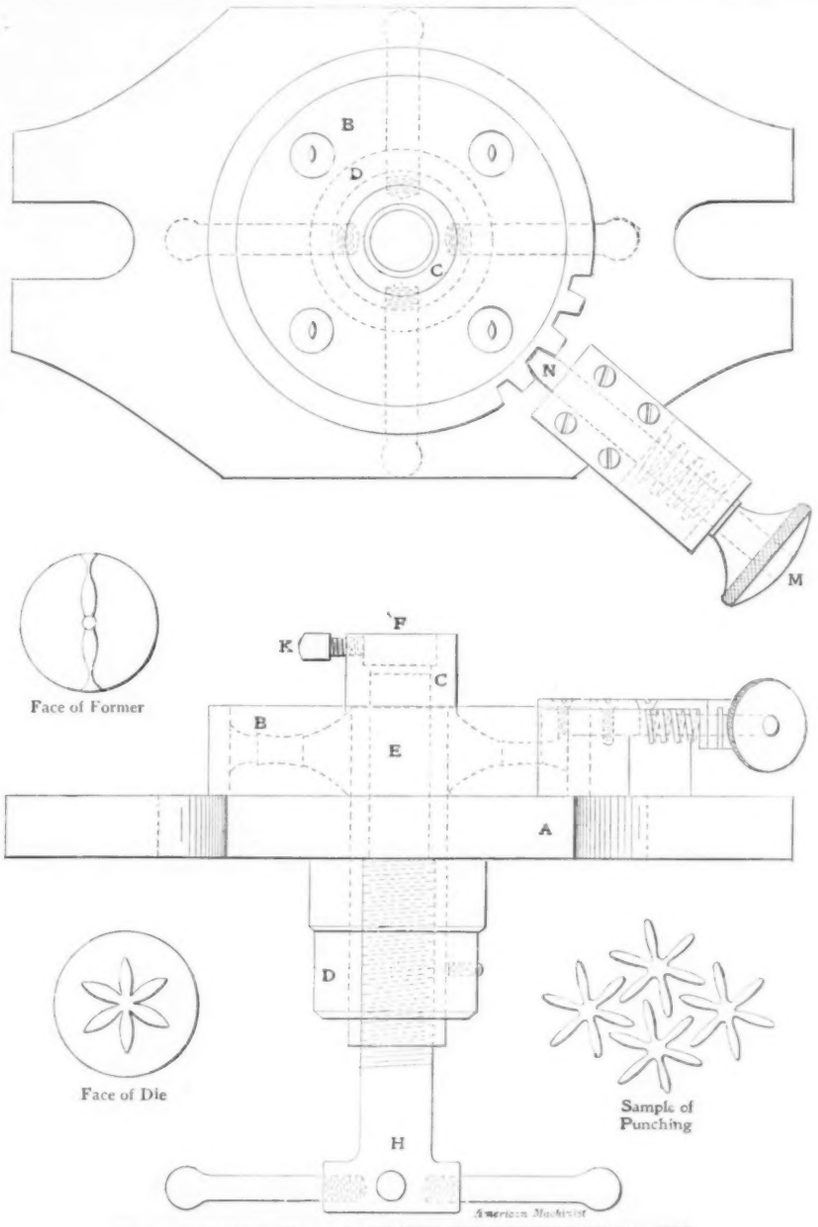


FIG. 2. GRADUATING ATTACHMENT FOR WORKING SMALL DIES.

placed in the hole *F*. The former or punch is held in the spindle overhead. It trims or forms only two opposite arms at a time. The die is brought around until a pair of the slots is brought even with the former. Then by using the foot on the lever of the press the former is brought down until it comes in contact with the die. Then the operator reaches under the press, and screws up gradually on *H*, which forces the bar *E* up until it comes in contact with the die. Then the die is gradually forced up on the former, which shears it to the exact shape. When the die has been sheared so far that the central tit of the former comes in contact with *E*, the die has been sheared enough, for all below that is backed off. Then screw *H* is withdrawn and the die is pressed back in place again. The set-screw *K* is then tightened on the die while the former is being raised, otherwise the die would stick to the former, and would be difficult to remove. Of course, each time the die is being forced up, the set-screw is loose. By pulling back on the nurled nut *M* the finger *N* is pulled out, and the gear may then be turned around until the next arms in the die come in line, and so on until they are all finished. There were several other dies of similar shapes that were finished in this jig, and in all it proved quite a time saver, for these dies were pretty tough to finish to size by hand.

PATRICK J. KING.

Notes on the Use of the Gas Furnace.

Editor American Machinist:

As the gas furnace is rapidly coming into common use in the toolroom for hardening and tempering the ordinary products of that department, and as I have had considerable experience in the use of such furnaces, I thought a few notes on the subject might not come amiss. Right here I wish to say that I believe there is no subject in connection with toolroom work more open to adverse criticism, as I have long noticed that the experience of different men in this line differs in a way which is remarkable. However, I will endeavor to describe some hardening and tempering methods and kinks just as they came to me thru practical experience.

I well remember when the first gas furnace was installed in the toolroom where I was employed. It was something of a curiosity to us all and we did much speculating as to how to light it. The different opinions then expressed suggest to me that it will be well to mention that the only safe way to light an oven gas furnace is to turn the air full on first, next light and place in the oven some inflammable material, such as paper or waste, then slowly open the gas valve, when the gas will be carried by the air pressure to the oven, where it will ignite with more or less of an explosion—the quicker the gas valve is opened the greater the explosion which takes place. When lighting the furnace it should be borne in mind that the oven door should be left wide open until the gas is well ignited.

The furnace which we are now using had no special means provided—as, indeed, is the case with most of them—for drawing the temper color. For a large piece I prefer to run the furnace up to a good heat, then shut it off and hold the piece to be tempered right inside the oven until the desired color is obtained: but for small pieces most people hold them over the ports at the top of the furnace, where there is, of course, a strong current of hot air and the temper may be quickly drawn; and by a little practise it can be drawn in just the spot you wish to draw it. This I have found to be a very misleading method of drawing, as I very often get false colors, probably caused by the imperfect combustion of the gas, the hot air in which the piece is held seeming to contain a substance which clings to the steel, sometimes producing a color similar to temper color long before the piece is warm enough to color naturally. To avoid this, I found a piece of gas pipe large enough to go around the outside of the port-holes, and cut off two pieces long enough to extend slightly above the top of the ports; then laid a piece of sheet steel about ¼ inch thick across these—the sheet steel being square and about 1¼ inches less than the diameter of the gas pipe, so as not to interfere with the free circulation of air thru the port-holes. These

pieces of sheet steel will be a dull red heat when the furnace is in use, and small pieces laid on them to draw are protected from the direct action of the hot air and the consequent danger from false colors.

There is a widespread idea that to heat perfectly a piece in a gas furnace, all that is necessary is to put it in the oven, close the door and "let her go." This, experience teaches me, is erroneous, as I have found that a piece may be very easily warped in the oven by allowing it to lie in one spot throughout the process of heating, and to obtain a perfect heat, pieces of any size, or pieces which are liable to warp, *must* be turned over and end for end at least three or four times while heating. The gas furnace offers exceptionally good means of heating pieces which are of unequal thickness or size, as you can run your furnace up to a fair heat before putting work into it, then put in the work and turn the gas valve as low as possible and still keep the gas ignited; allow the furnace to run this way until your work is evenly heated to the temperature of the oven, when by turning the gas on full the heat will run up to "cherry red" quite evenly over the entire piece. I know that the bane of the hardener's existence in many cases is the "checking" or cracking of work hardened; this I believe is usually caused by overheating or uneven heating.

In the last few years I have hardened many difficult pieces successfully by simply being careful in heating, as previously spoken of, and being particular not to allow the piece to stay in the hardening bath longer than really necessary, as experience shows that a piece may be removed from the bath while enough heat remains in it to cause the water to boil and yet be very hard. In case the piece, thru error of judgment, is left in the bath long enough to be cold, I immediately reheat it so water dropped on it will boil, to take out the strains which cause it to check. I once saw a lot of about fifty small pieces which were hardened but not reheated or tempered, just before quitting time at night, and which were apparently all right, but next morning the hardener was surprised to find that all but three were checked. I expressed the opinion that if they had not been left in the hardening bath until *cold* or had at least been reheated at once this would not have occurred. The hardener tried this on the next lot with perfect results.

Such pieces as hollow mills for turret lathe or screw machine work are handled with much more certainty of good results if they have a small hole throughout their entire length so the hardening fluid will have a chance to cool the mill more evenly. I once heard an old hardener say that if a hollow mill with a solid shank was dipped in the hardening bath, as is the practise in many shops, only to the depth which it was fluted, that the steam alone in the inside of the mill would be apt to break it. However that may be, I have seen many hollow mills having solid shanks checked and comparatively few when drilled their entire length. Pieces such as circular form cutters having one or more diameters which are much larger than the body of the cutter are very apt to come out of the hardening bath in sections unless the large diameters are sawed thru down to the body at three or four points, because the large diameters cool much more rapidly than the body of the cutter and become very hard while the body is still cooling and shrinking, with the almost invariable result that the larger portions not being able to continue shrinking with the body, snap or break off, frequently coming off from the body as entire rings. Very small pieces may be conveniently handled in the gas furnace by wiring them together with small, soft wire, thus handling them in bunches. When drawing the temper on very small pieces a small piece of drill rod magnetized at one end affords a very convenient means of handling them. I have a very simple method of tempering a hammer which may or may not be generally known and is simply to grip the hammer thru the eye with the "pick-up" tongs and dip the small end nearly up to the eye long enough to harden it, then reverse the hammer and dip the large end; the temper is then drawn from the heat in the stock surrounding the eye. I have never checked a hammer hardened in this manner. Always remember that it is best after drawing the temper to cool the piece just enough, by dipping in oil, to be sure it will not "draw" more, then put it in a moderately warm place and allow it to cool gradually, as a piece must not be finally cooled quickly if you wish it to be tough.

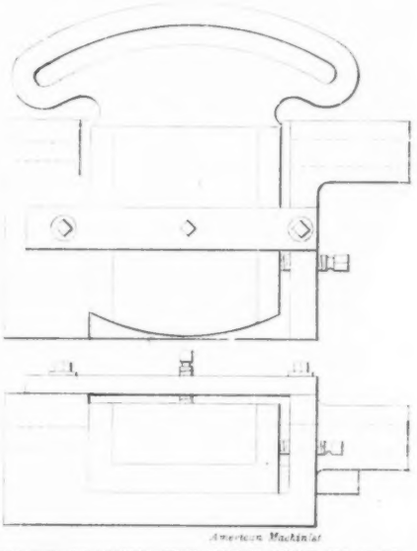
High-speed and self-hardening steels may be thoroughly annealed by packing in a gray-iron box with gray-iron chips and slowly heating to a good color, then shutting off the furnace and covering up the ports tightly to prevent the cold air from coming in contact with the steel allow the work to stand until cold. A great many firms do their case-hardening in the same furnace in which they harden their tool steel. This is, I think, poor practise, especially if you use cyanide of potassium for case-hardening, as the bottom of the oven becomes saturated with cyanide, which certainly does not improve your chances of hardening difficult shapes in tool steel successfully. However, if you make a sheet-steel pan or dish to hold the work, it can, perhaps, be done without very serious harm.

I have used lately a hardening solution which I think is an exceptionally good one, but do not know if it is in general use. It is made by adding enough salt to pure rainwater to just float a potato, then adding to every 20 gallons of the solution about 8 ounces of vitriol. This solution will harden some of the milder steels at a much lower heat than any other I know of. This is, I think, a great advantage, as one of the greatest dangers of checking lies in overheating. When the proper amount of vitriol is in the bath it will feel slightly slippery to the fingers, and tools properly heated and dipped will have a beautiful silvery appearance. If any black spots appear upon them, you will generally find such spots to be somewhat softer than the rest. Last but not least, always when practicable, dip the heaviest or most solid part of the work first. H. ARDEN.

Fitting the Taper Pin in a Clapper Box.

Editor American Machinist:

Most any fellow running a planer required to produce close work understands the importance of a properly fitting tool block, or clapper box. There are, however, a great many who don't know how difficult a job it is to fit one correctly. It is not such a hard matter to fit the two castings together, but it is not so easy to fit the taper pin in nice and square. The pin if out of square the least bit will cause the block to lift obliquely and then either the block must be relieved or the hole



JIG FOR REAMING THE TAPER HOLE IN CLAPPER BOX.

enlarged. If the hole is made large, the action of the tool will be uncertain on light surface cuts, and if the block is scraped off on the sides, it then becomes a hard matter to get a good, even, side finishing job. I have seen a number of new planers with a little play in the tool block, where it had been scraped off to relieve the error caused in fitting the taper pin.

In three or four shops that I know of, it is the general practise to drill and then bore the taper hole on a lathe, using a taper attachment. That method is necessarily slow on account of the smallness and length of the hole, and the long, light boring tool to be used.

The builder of a very good planer told me he could duplicate any part of his planers except the tool block, and the reason he could not do that was on account

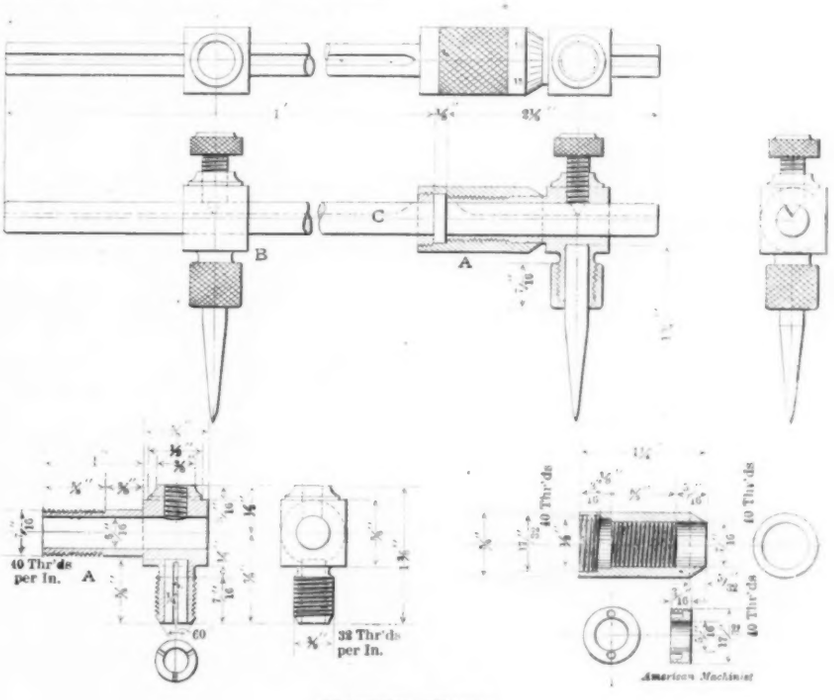
of the taper hole. There is hardly another part more liable to breakage than the clapper box, and, as it would be a very hard and expensive job to bore the holes standard on a lathe, a jig something like the sketch might be used to guide the reamer and a quicker and better job could be done. There should be a roughing and a finishing reamer and they should be made with a bearing on each end to fit the straight holes in the jig indicated by the dotted lines. CAMERON.

Trammel With Micrometer Head.

Editor American Machinist:

Herewith is a working drawing of a pair of improved trammel points. A section is shown thru head *A*, which has micrometer adjustment; and head *B* is practically a duplicate of *A* with the threaded sleeve omitted. The points are held by means of a slotted sleeve, as shown, and can readily be replaced with longer points if the work requires, or a lead pencil can be substituted if desired.

The object of the micrometer adjustment is not for definite setting, but only to facilitate setting to a scale. For example, if we wish to set the points to 8½ inches and after locking them by the nurled screws we find we are out seven or eight thousandths of an inch, it is then only necessary to release the nurled screw in head *A* and make the correction, which is quickly done. The bar *C* can be made



TRAMMEL DETAILS.

any convenient length and may be indefinitely extended by means of other bars with a socket at one end fitted with a conically pointed screw to fit the V-groove in bar *C*.

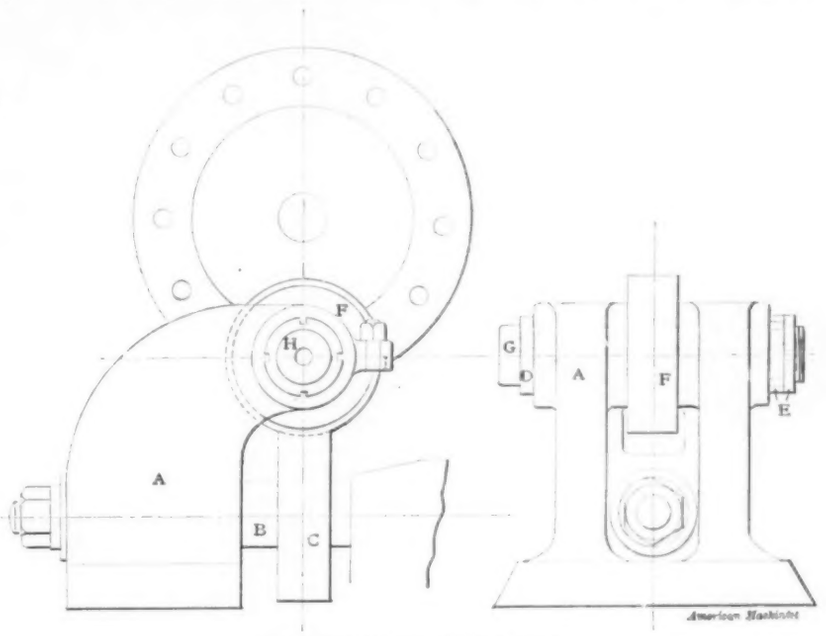
The details of the screw will be readily understood without further description.

R. J. KRUSE.

Jig Making on the Gear Cutter.

Editor American Machinist:

The fixture shown herewith is used on a Brown & Sharpe gear cutter for drilling the bushing holes in the jigs used for drilling the stud holes in high-speed steam-engine cylinder covers, Corliss valve "bonnets," etc., and in fact any kind of drilling jig which is circular and requires to be set out accurately. It is constructed in the following manner: *A* is a gray-iron bracket terminating in two bosses at the top; this bracket takes the place of the outer support to the cutter spindle. The latter is shown at *B* in the sketch and carries a spiral gear *C* which is mounted upon it in place of the gear cutter. *D* is a steel sleeve with a collar on the front end to take the thrust, and held in position by two lock-nuts *E* at the back end. *F* is a spiral gear which meshes with *C* and drives *D* by a feather. *D* is bored out Morse taper and carries the drill socket *G* which carries the twist drill. *H* is a ½-inch round hole drilled thru the back end of sleeve *D*, this hole receiving a rod



JIG BORING ON THE GEAR CUTTER.

to knock the drill socket out. *I* is a lug cast on each boss of *A* and split across after *A* is bored, a brass strip being inserted in each slot and the boss tightened up by the set-screws shown to provide for adjustment when the sleeve gets worn. The jig to be drilled is mounted on a suitable mandrel in place of the gear blank and the cutter slide which carries the drill in motion fed forward the required distance. The slide is then withdrawn automatically, and the machine divides the work for the next hole. DANUM.

England.

When the Boiler Gave Out.

Editor American Machinist:

The Second of the "Hamilton" leaned against the washstand in the Third's room and his eyes twinkled. The Third, half awake but wholly wild, was slowly divesting himself of his sleeping apparel and getting into his overalls, as well as the rolling of the ship would let him. And as he dressed he cussed; it was A. M.

A tube had split in the starboard boiler, necessitating its being disconnected for temporary repairs, and the turning out of the Third to lend a hand—hence the language. If the Third had been asked why he cussed, or the Second why he listened, they would probably have said that it was the only pleasure they had, and the pleasures of the seafarer are few and far between.

The Third, whose name, by the way, was MacIntyre, once in his 'prentice days

owned a pony. He was fond of the pony, in his own way, and if ever he passed over the reins to a chum it was with the injunction, "Don't use the whip, chum; I don't mind giving her a touch up myself, but I'm not goirg to let any other do it." This is apropos of the fact that Mac, or any tramp-ship engineer, will agree with his shipmates in passing scathing remarks about her build, her abilities to travel, her machinery, lack of comfort—anything, indeed, from her owners downwards comes under his denunciation. But let any misguided wretch from another ship or the shore try to do so, and see what happens. The "old hooker" becomes a fine-lined ship, her machinery a clock, a home to her engineers, and she suddenly has acquired the capabilities of a mail ship. Such is the fickleness of man.

The Second having taken his departure, Mac finished his toilet by wrapping a sweat rag round his neck, pulled an old cap well down over his ears, and followed him down the ladder. A boiler job was nothing new on this ship, as she was old, and her boilers in poor shape, so Mac knew exactly how to start in a systematic manner to fix the leaks. When he reached the boiler-room he found the fires being drawn, and as his presence wasn't necessary for half an hour yet, he busied himself getting out the tools, a stopper-rod, planks, etc. Having next got the ash-pans and smoke-boxes cleared, he proceeded to inspect the damage. Pushing a plank right in over the bars of the furnace, he took a lamp and piece of chalk and crawled into the combustion chamber. On account of the heat the preliminary inspection is a hurried job, as there is still some pressure in the boiler, and in passing under a leaking tube plate you have to move kind of lively.

The first furnace showed a screwed stay leaking, and some tubes at the tube plate. There was also a little caulking to do at a joint. All this he carefully chalked over. The next furnace had a leaky saddle patch and rivets, also some more tubes to expand. The last had the split tube, and some seams to caulk.

The boiler was now pumped down as far as necessary, and the work commenced. The Chief took charge of the engines and boiler-room while the Second and Third tackled the boiler. The nut on the leaking stay wouldn't answer the wrench and hammer, and had to be split to get it off. The die nut was then run down the stay, as the thread was in good shape, and a new nut found to correspond. They didn't always have such luck, sometimes having to chip and file away an old thread to screw the stay a size smaller, which in the limited space of a combustion chamber is a trying job—to say the least.

The plate was then carefully caulked around the neck of the stay, a thin strand of asbestos cord and white lead applied at the caulking and the nut screwed on and tightened up. The tube expander was next introduced to the leaky tubes, and half an hour later that box was finished. The Third climbed out and, while cooling off under a ventilator, a fireman shifted the tools and gear to the next furnace.

The leaking patch had never been a satisfactory job, but as they couldn't get it renewed it just had to go at that and continue giving trouble. As the Second said, with a sardonic grin, "It's only a question of time when the boilers will be renewed." This was the "super's" gag. Well, they got the rivets caulked up tight and then caulked the patch itself, but it was as the new piece of cloth on the old garment, and they knew it would be just as bad again when steam was up. There were other patches in the boiler, as Mac said, "like tiles on a roof, till you couldn't tell which was the original pieces of boiler," but this particular patch was in such a position that it received the impact of the flame on its lower edge where the weak riveting was, and the unequal strain caused the leaking.

The stopper for the split tube consisted of a rod screwed at each end, with nuts and two cast-iron disks. An asbestos washer at each end formed the joint. They had another type of stopper-rod on board, consisting of the usual rod passed inside a small tube about 6 inches shorter than the smoke tubes, a rubber plug at each end with two washers and a nut. The advantage of the latter type was that it could be put in place and tightened up without drawing the fire. Its disadvantage was that it could only be used in the case of a split tube, and a clean one at that, as the back end plug had to pass right thru the tube. As the "Hamilton's" boiler tubes were more or less choked with salt and ashes, caused by the chronic leaks, they always used the rod and disks, as most of the tubes could barely pass the rod, far less the rubber plugs.

All being ready, the rod was pushed thru the tube, the washers and disks applied and the whole tightened into place. Among the tubes to be expanded was one which was so weakened with repeated expanding that it was found advisable to put a stopper in it covering the ends of the tubes, this being the last job.

By this time the boiler was filling again, and the men were getting out coal ready to set the fires away. Mac, with his pipe lit, was standing by to let the Second have his breakfast. When the water showed in the gage column, a last look in the back connections assured him she was still tight as a drum, so he gave orders to coal the bars.

When the Second arrived below he found the tools and gear being cleared away, fires burning brightly, and a hungry looking Third mopping a dirty face with an even dirtier piece of waste—but withal cheerful.

"Well, Mr. Smith, how long do you give her to hold out?"

"That's a problem, Mac."

The Third smiled again, shook his head, and started up the ladder. X. Y. Z.

Machining a Large Flywheel on Small Machines.

Editor American Machinist:

The sketches show what I designed to machine a pair of 16-ton blowing engine flywheels in an 8-ton shop. The boring mill housings had to be removed to swing the wheels. With two pieces of gray-iron flange pipe and an old rail, I got up a rig that made a fine job of the boring.

A is the table of the 7-foot boring mill, *B* is a piece of pipe turned on the outside,

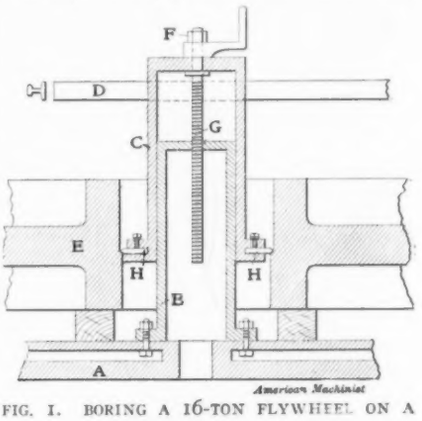


FIG. 1. BORING A 16-TON FLYWHEEL ON A 7-FOOT BORING MILL.

C is a piece of pipe bored to fit the pipe *B*, *D* is a piece of rail clamped to the pipe *C* and held to prevent it turning. *E* is the flywheel. *F* is a nut which, when screwed up tight, prevents the feed screw from turning in the casting *C*. The pipe *B* is bolted concentric with the table *A*, as is also the flywheel *E*. The flange of the pipe *C* is fitted with cutters *H H*. The feed screw *G* is 16 threads per inch. It is obvious that if the nut *F* be tightened so as to prevent the feed screw *G* from rotating and the rail *D* be held to prevent the pipe *C* from rotating, then when the mill carrying the flywheel *E* is started, the

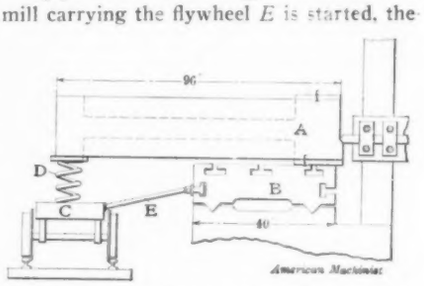


FIG. 2. PLANING THE FACE OF HALF WHEEL.

cutting tools *H H* will be advanced by the feed screw *G* and bore the wheel *E*.

The planing of the joints of the two halves of each wheel was accomplished on a side-head planer by taking down one housing and supporting the overhang of wheel, as shown in Fig. 2. Car springs were used to ride the wheels to compensate for the inaccuracy of the tram car and rails. The car was braced to the platen at both ends, so was positive in its travel.

A is the half flywheel, *B* is the 40-inch planer table, *C* is the car, *D* is the car spring, and *E* is the brace from car to

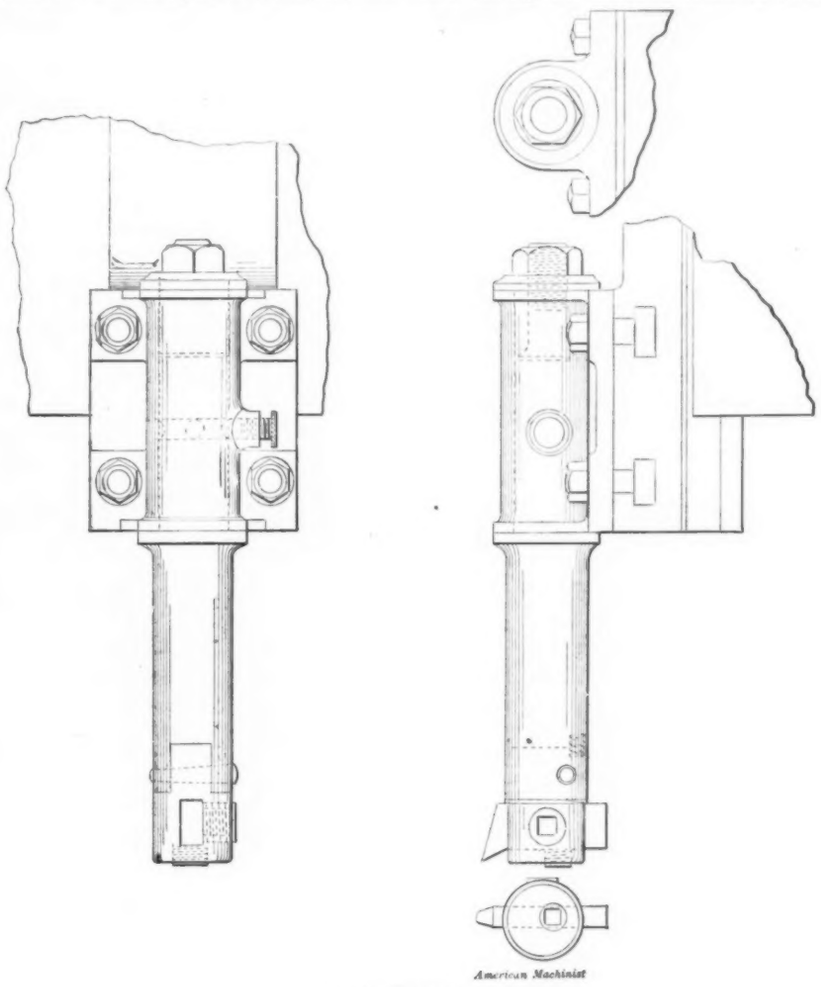
planer table. The wheels have been running for two years alongside of wheels built with modern tools, and are their equal in every respect.

IVOR W. JONES.

Slotter Tool Relief.

Editor American Machinist:

At page 1146 are shown several forms of slotter tool reliefs. The heavy spring reliefs are of little value on the slotter in general manufacturing or railroad shops. For slotters up to 18-inch the best form of tool relief is illustrated herewith; it is adjustable to four positions—front, sides and back. For clamping the tool, two holow set-screws are employed. The bottom set-screw is first tightened, taking up the play of the tool, then the side set-screw is firmly tightened. A square-ended wrench is used.



SLOTTER TOOL.

This is the best design for holding the tool that I have ever seen on the slotter.

F. RATTEK.

Babbitt Bearings.

Editor American Machinist:

Numerous articles have appeared in these columns on material and design of bearings, but in no article that has come to my notice has the possibility of dust, sand or other flying particles getting into the bearings, been considered. The surroundings of bearings should form a most important item in chosing their material, for it can be practically demonstrated that a good bearing in one place will not do at all in another.

Imagine a set of locomotive links with babbitt-lined surfaces working on soft steel pins and blocks; yet they will undoubtedly give as good service as any babbitt bearing if encased in a dust-proof box. The locomotive represents a good example in actual practise, where it is quite impossible to prevent gritty substances from getting into the bearings; and having had more occasion to notice the action of soft metal bearings on steel about a locomotive than on other machinery, I will consider it only. There are, however, many other similar cases, such as machine tools exposed to the dust from emery wheels, especially when the wheels are being trued up, also foundry machinery, etc.

But, to return to the locomotive: Some may reason in designing bearings for driving axles, that it is easier to renew the bearings than the axles, and so make them of the softest material allowable, say babbitt, thinking they will not wear the steel axles very fast. That babbitt bearings will wear and cut locomotive axles much faster than will harder ones can be easily explained. Sand and other particles of grit flying up from the roadbed will get into the bearings and the axles will carry the grit around until it becomes firmly lodged, after which each grain of sand thus lodged begins its work of cutting into the axles. The axles will then wear away the babbitt in grooves where it is not protected by the sand, while the latter cuts deeper into the axles. With bearings entirely of brass the action of sand is, however, quite different. It will be crushed to a fine dust unless it is very hard, or it will be rolled around in the bearing until it gets out. To lodge sand in brass will be found quite difficult, which an attempt with a hammer will demonstrate; unlike in babbitt, the sand will indent the brass, but it will not hold and can easily be brushed away. This property of brass makes it probably the most suitable of all metals for bearings that cannot be kept free from foreign substances and that cannot be hardened.

The action of sand in a brass or other metal bearing spotted with babbitt is similar to an all-babbitt bearing, except that the latter will probably injure a journal much faster. Some readers of the following will perhaps not accept it: In repairing a pair of all-brass rod brasses which had too much lateral freedom, someone had fastened a ring of babbitt to one side, thus increasing the bearing length. There was then about 4 inches all-brass and ½ inch all-babbitt surface acting on the pin. How long this combination had been in use I do not know, but when the brasses were taken off the pin, the latter had a groove 1-32 inch lower than the rest of the pin and just the width of the babbitt ring. Of course it was not the babbitt that wore the pin, but the sand that had become lodged in the babbitt; and altho brass and babbitt were subjected to the same conditions, no sand could be detected in the brass, tho there was enough of it in the babbitt.

Use no babbitt for bearings that cannot be kept free from foreign substances; and if brass is used, it should be solid—that is, not porous—and soft, since sand will then compress it before cutting into it.

R. F. KREITER.

A Simple Method of Proving a Multiplication.

Editor American Machinist:

The method of proving a multiplication offered by H. I., on page 1373, cannot always be depended on, and is therefore not really a proof. For instance, multiply 37 by 29. If done correctly, it would be:

37	10	1
29	11	2
		$1 \times 2 = 2$
333		
74		
1073	11	2

Suppose the mistake was made of putting down 54 instead of 63 for 9 times 7,

then the multiplication would show this way:

```
 37    19    1
 29    11    2
                   1 × 2 = 2
324
 74
1064   11    2
```

This apparently proves correct if the method suggested is used. The number of such errors which might arise is unlimited and no such method should be used for checking a multiplication. D. E. M.

A Flexible Ruler.

Editor American Machinist:

Having received so many useful ideas thru your paper, I feel that I would like to suggest some in return. One of these is in the nature of a flexible ruler. There are many on the market, but I doubt if any can be so cheaply made and answer the purpose as well as the one I am about to describe.

In the cross-sectional view the center portion is lead and the outer surrounding portion is rubber tubing. This view is of course an enlarged one. To make the ruler, a strip of lead ¼ inch wide and about 3-32 inch thick and of any convenient length is cut so that the edges are straight. Over this strip is drawn a piece of rubber tubing which must be small

CROSS-SECTION OF FLEXIBLE RULER (ENLARGED).

enough so that when it is pulled into place it will be stretched and fit snug.

The rubber surrounding the lead strip not only prevents the lead from smearing the drawing, but also keeps the ruler from slipping. It will be found that this ruler lacks proper resiliency, but this is more than compensated for, thru the fact that it will hold its curve better than its more sensitive contemporaries.

After the ruler has been used some time its edges become irregular; these "humps" can be removed easily by simply rapping the ruler on a smooth surface a few times.

When the edges become too irregular so that they will no longer make a smooth curve, the ruler can be cast aside and a new one made, since it is so cheaply gotten up.

By way of a closing remark, I wish to apologize to all who have already used such a ruler. F. W. Burger.

Drilling Glass.

Editor American Machinist:

I have noticed in your columns, from time to time, different methods of drilling glass. The method employed by the American Arithmometer Company, of St. Louis, I thought would interest some of the readers, altho it is not new and has doubtless been described before, altho I do not remember of ever having seen it.

The glass to be drilled is plate, ¼ inch thick. It is located carefully in a jig so as to get the right location for the 1-inch hole. This jig is provided with a bushing to guide a piece of 1-inch copper tubing with 1-16 inch walls. Flour of emery and water are used as a cutting agent. The copper tube is put in a small bench drill that makes about 75 revolutions per minute. When the glass is drilled about halfway from one side, it is turned over and drilled from the other side. A very good, clean-cut hole is obtained in this way in about three minutes time. Glass.

Embossing Dies.

Editor American Machinist:

I have lately had a number of large embossing dies to make, some of which have been of a very intricate design. Our usual plan when making these dies has been to make the female of brass and the male of white metal. To do this we let the brass plate into a gray-iron body, this having lugs for holding it down to the bolster plate. The top plate is also gray iron exactly like the bottom, and both of these are machined true on the top and bottom faces. After the design has been finished on the brass plate, we fix it into the gray-iron body, then bolt the top and the bottom dies together; this leaves a space to be filled with white metal. In dies of very fine design this white metal has been a lot of trouble, as after we have embossed a few thousand sheets of tin it becomes faint, owing to its soft nature. We can do about 5,000 sheets at one melting, but when we have an order for 30,000 and more this means remelting many times, which is a lot of trouble and expense. On our last order but one, we thought we would make both top and bottom dies of brass. This we have found to be very costly on dies where the design has been of an intricate nature, so we decided to have a try with other metals that could be melted in an ordinary blacksmith's fire. We thought that aluminum would fill the bill, so ordered a few pounds; our first experience in melting this I cannot describe as a happy one, as we burned the bottom out of the vessel before the metal began to melt; however, we got a new one and were this time more successful, as we got the metal to a thin liquid state. We then poured the mold (after having warmed it); we allowed it to cool of itself, and after taking it apart began to congratulate ourselves, as the face of the metal was very smooth and followed the design closely, but when we tried it in the press we found the metal had shrunk considerably. This caused the male design to be too small for the female, and when the tin was embossed it looked faint. This would not do, and as there was no further time to experiment, we had to use our ordinary metal.

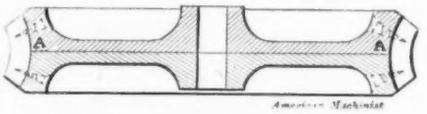
My object in writing is to gain knowledge, rather than to impart it, but everyone's experience is new to someone, so I have therefore sent mine. What I desire is, however, to draw out from your readers who have had experience with embossing dies their practise in the making of these dies, what mixture they use, how they melt and pour it, and any other information that will be useful. In conclusion, I will say that if the aluminum had not shrunk so much, it would have been excellent for the purpose, as its face was very smooth and hard, these two points being very important. Foreman.

S——, England.

Making a Worm Gear Pattern.

Editor American Machinist:

I read with interest the article by Mr. McVeen, at page 1303, describing his method of making worm-wheel patterns. My way, which I have never seen described, and which may possibly be original, is somewhat different. The body of the pattern is made in halves, as shown in the sketch, parting it on the line *A A* and molding it in a three-part flask like a sheave. The teeth are got out very roughly of hardwood, fitted nicely to the pattern body and fastened by slender wood screws. The pattern is then put in the lathe and turned on the outer faces and on the ends of the teeth. A hole is put thru the center of the pattern and it is mounted on a



MAKING A WORM GEAR PATTERN.

stud on the cross-slide of an engine lathe. The iron worm pattern, having previously been made, is heated to a dull red and put on the centers of the lathe and driven at a good speed. Then by feeding the pattern in against it the teeth are very quickly burned to a perfectly correct shape. This operation can be done on a wheel 2 feet in diameter in 15 or 20 minutes, making the teeth more accurate and uniform than can be done in any other way that I know. After the pattern is sandpapered and varnished, a deep line is cut across the joint on each end of each tooth and the teeth are numbered, so that when they are removed they can be accurately replaced. As they are stuck with varnish, they must be taken off and cleaned and refastened.

In molding, the whole wheel is rammed up and all the screws are removed before drawing the body of the pattern. This leaves all the teeth in the sand, and they are very easily drawn inward without disturbing the sand and leaving no central joint to show in the casting. It makes a casting almost equal to a cut gear, requiring but little smoothing with a file.

Wm. Merrill.

A Coating for Metal Patterns.

Editor American Machinist:

After trying several different coatings, such as wax, shellac, etc., on small, complicated metal patterns I discovered that

the lacquer used by platers exactly fills the bill. It covers every part, gives a hard, smooth surface, and at the same time is the thinnest coat possible. It is good on aluminum patterns, as it flows readily into all the small blowholes, and it is not necessary to file the pattern out of shape to get it smooth. It is about as cheap as any other coating, when you take into consideration the amount of surface it will cover, and it will last for years. A pattern so treated cannot rust or corrode.

Get No. 1 brush lacquer and thinner; a pint of each will be enough for a good many patterns. Thin the lacquer with the thinner until it flows easily, then apply with a camel's-hair brush. Dry in a warm room as free from dust as possible. The best plan is to hang each pattern up separately in a loop of wire. The lacquer and thinner can be obtained from any dealer in platers' supplies or in almost any plating plant.

KIOWA.

A Turret Lathe Pulley Turning Rig—Wheel Grinding.

Editor American Machinist:

The photograph, Fig. 1, shows my method of turning pulleys with an old style turret lathe, the rigging being devised to employ unskilled labor, of which there is a superabundance in this vicinity, while skilled mechanics are as scarce as hen's teeth.

The lathe shown is 16-inch swing and

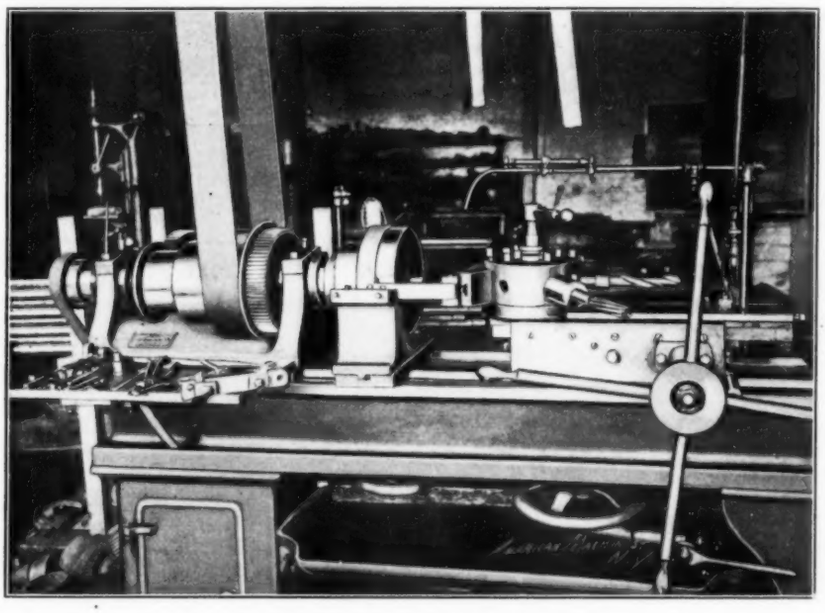


FIG. 1. TURRET LATHE PULLEY TURNING RIG.

is at work on a lot of crown-face pulleys, 10x3x1 inch, the roughing cut being shown about halfway across the face of the pulley. The finishing tool is shown resting across the corner of the shelf attached to the headstock.

The piece in front of the pulley is a gray-iron standard, faced with steel where the tool-holder rests upon it. In front of the tool-holder is a raised ledge upon which is bolted a steel guide plate, in this case concaved ⅛ inch to the foot to give a proper crown to the pulley, the tool-holder having a tool-steel circular plug bearing against this guide. For straight work the guide-plate may be reversed, and then may be used either for parallel or for taper work up to 6 inches to the foot.

The cutter is very solidly supported, there being no overhang, and as heavy a cut as the lathe will pull may be taken without any spring or chatter. I use a small independent chuck with special long jaws, usually chucking the pulleys by the hub (using four jaws for four-arm pulleys and three jaws for six-arm pulleys), thus allowing the pulleys to be bored and turned at the one setting.

The gray-iron piece on the face of the turret is T-slotted its entire length, and the tool-holders are pivoted in a tongued block, which may be bolted at any distance from the center of the lathe to suit the work in hand.

The finishing cutter bar has, in addition to the finishing cutter, two cutters sliding in grooves planed across the top of the bar. These two cutters are for finishing the edges of the rim, and may be straight, or, as in this instance, formed to finish the rim with a round edge. The cutter nearest the turret is stationary; the cutter

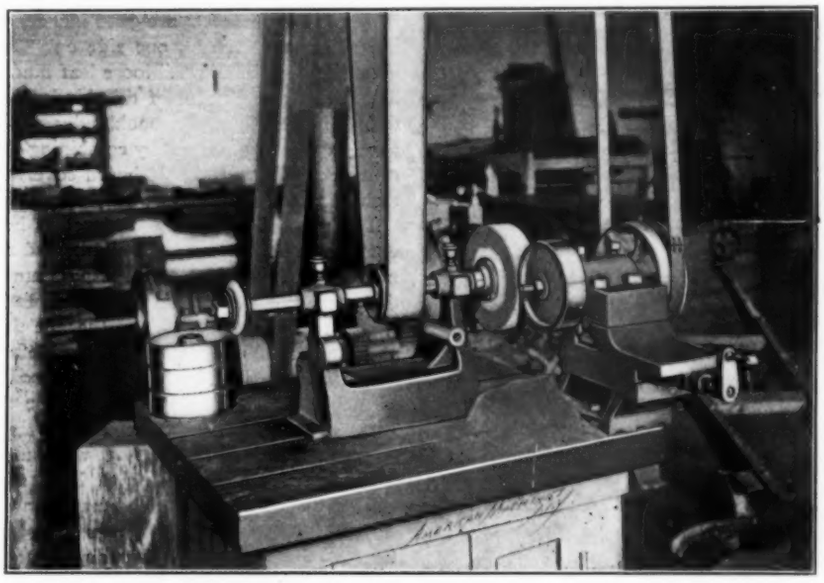


FIG. 2. GRINDING TRUCK WHEELS.

at the front end of the bar is slipped back until the finishing cutter clears the face of the pulley. The cutter is then moved inward about ½ inch and both edges are finished, the width of the face being gaged by turret stops. This may be done as quickly as the turret could be rotated to bring another tool into action.

The vertical pin thru the end of the cutter bar is tapered, and preference is given to changing the bars instead of rotating the turret and using two stations. I find this a very efficient tool for turning bevel gear blanks and similar taper work.

The gray-iron standard or guide block may be adjusted inward or outward to suit the diameter of the work, and will take any size up to 12 inches, that being as large as will swing over the base-plate. We have turned a lot of 10x3x1-inch crown pulleys, finishing eight per hour running at a speed of 20 revolutions per minute.

Fig. 2 shows a cheap but efficient grinding rig for finishing the faces of truck wheels 7 inches diameter and 1¾-inch face. The work holder is a full swing rest from a 24-inch lathe with boring tool holder in place. A gray-iron sleeve bored 1 inch and turned to fit the holder is held by the two set-screws. A mandrel turned to fit the bore of the wheels and having a 9-inch pulley on the other end belted to the countershaft of the grinder completes the rig, the whole cost being inside of two dollars.

RICHARD THIRSK.

Cordova, Ala.

A Simple Foundry Order System.

BY C. G. BEEDE.

As an example of a method well within Mr. Ridderhof's definition of "system" at page 1165, and somewhat beyond his loose-leaf-of-scrap-paper stage of development, the following is offered as a practical scheme for keeping track of castings when depending on an outside foundry. It was devised after experiencing considerable annoyance from delay in the filling of our orders and some differences of opinion with the foundryman as to shortage or excess in the number of castings delivered.

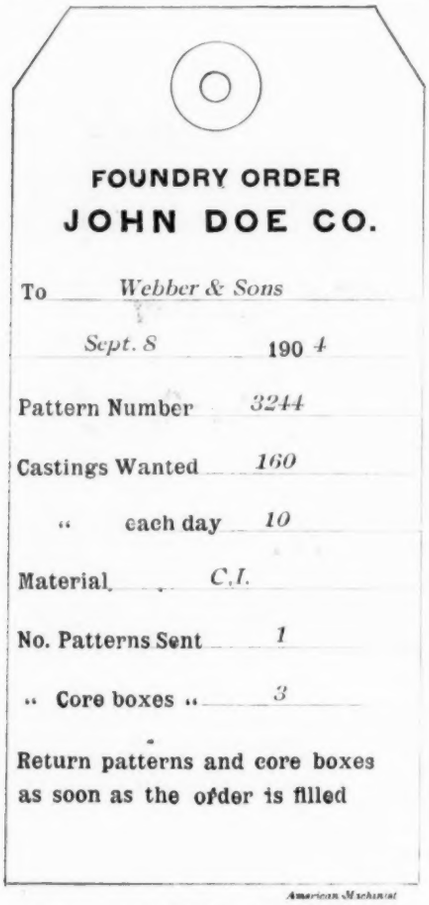

FOUNDRY ORDER
JOHN DOE CO.
To Webber & Sons
Sept. 8 190 4
Pattern Number 3244
Castings Wanted 160
" each day 10
Material C.I.
No. Patterns Sent 1
" Core boxes " 3
Return patterns and core boxes as soon as the order is filled
American Machinist

FIG. 1. THE ORDER TO THE FOUNDRY.

The patterns are stored at the shop and are marked by figures which show plainly on the casting. To each different pattern to be sent to the foundry is attached a tag which is shown in Fig. 1. The date and name of the foundry are filled in by a two-line rubber stamp, as from 20 to 250 of these may be sent out at one time. The number of patterns varies, since when the piece is small, enough of one number may be sent to fill a bench flask. The blank for the designation of material extends the use of our tag to the orders for the different mixtures of the brass foundry, as well as for gray and malleable iron and steel. It also states how fast we want the castings delivered. The other side of the tag (not shown) is ruled for the molder's record. This may seem unnecessary, but the additional cost is small and it is a great help to the man in keeping his count correct. This tag tells the foundry what we want and how fast we want it. They acknowledge the receipt of this order and the patterns by signing and returning the blank shown in Fig. 2. This is merely a list of the patterns sent, the signature showing that the signer has received all these, examined the order tags, core boxes and patterns and found them to agree.

Our record of the foundry orders and the receipt of the castings is kept as shown in Fig. 3; these sheets are 9x12 inches, being ruled and used on one side only, and bound in the "S. and T." loose leaf binder. The nearest stock size of this binder was 6x8⅞ inches, but the bookbinder easily gave us what we wanted by combining this neat device with a simple board cover the right size for our sheets.

The number of castings ordered is here entered in its proper date column and the number received on a following date is deducted and the remainder placed under that date; the last number in the line thus showing the number due. In case defective pieces are found or some are spoiled in machining, a small figure placed in the date space indicates that this number is to be added to the number due us when making the next deduction; a tag, Fig. 1, being made out ordering this number additional of the foundry, these tags being sent on the daily call of the foundry team.

Should the foundry fail to send as ordered the castings of any particular number, this fact is made prominent by the blank spaces opposite this number. A telephone notice is generally all that is needed to bring the delinquent along properly.

The patterns are supposed to be returned as soon as the order is filled, but as this is not always done promptly, nor are all those of one number sent together, the "Returned" column for both patterns and core boxes is a little wider, to take several entries whose sum shall equal the "Number Sent" column in both cases before the space in column headed "Patterns Returned," to the left, can be checked off. These two columns to the left of the date columns are for check marks only, and are placed there to readily catch the eye in running over the pages, and so avoid the trouble of looking over the date columns to see whether or not an order is filled and the patterns are back at the shop.

The sheet, Fig. 3, gives the record for one month only. As deliveries often extend beyond the end of the month, a sheet headed the same as Fig. 3 but extending to the left only as far as line *A B* is inserted for the next month's record. This leaves the two columns headed "Order Filled" and "Patterns Returned" always in sight, however many months' sheets may be added to the first.

The purpose of this system was to have a simple method by which the foundry should understand and acknowledge our orders, the patterns always be located, and the condition of the order be readily seen by a glance at the record. Some years of use in the form described has shown it to be sufficient for this purpose.

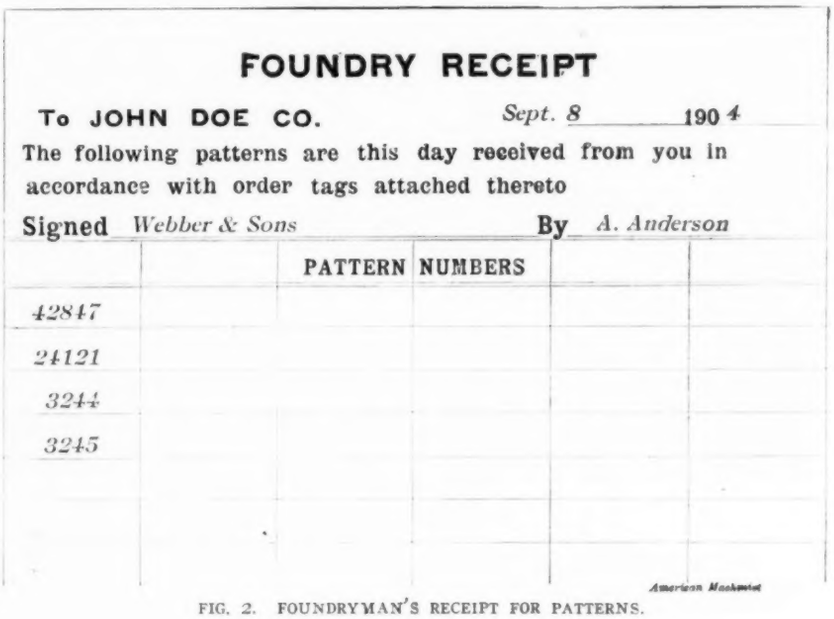

FOUNDRY RECEIPT
To JOHN DOE CO. Sept. 8 190 4
The following patterns are this day received from you in accordance with order tags attached thereto
Signed Webber & Sons By A. Anderson
PATTERN NUMBERS
42847
24121
3244
3245
American Machinist

FIG. 2. FOUNDRYMAN'S RECEIPT FOR PATTERNS.

The Merchants' and Manufacturers' Association, Pittsburg, Pa., have just been making a $10,000 tour thru Eastern and Southeastern Ohio. For the convenience of the excursionists and without cost to them, the Central District and Printing Telegraph Company arranged to install free telephone service on the special train. During long stops, each car was connected with long-distance wires and those aboard conversed with home. A telephone service also was established from one car to another. The test was the first practical one ever given, and, if satisfactory, the Pennsylvania lines west will probably install such a service on all thru fast trains. We note that the Brown & Zortman Machinery Company is among the concerns represented on the trip.

FOUNDRY RECORD FOR *September* 1904

Pattern No	Name of Part	Other Pulled	Patterns Returned	1	2	3	S 4	5	6	7	8	9	10	S 11	12	13	14	15	16	17	S 18	19	20	21	22	23	S 24	25	26	27	28	29	30	31	Material	No. Wanted Each Day	Patterns Number Sent	Patterns Number Rec'd	Core Boxes Number Sent	Core Boxes Number Rec'd	Extras Received	Foundry
42847	*Back Stay*	✓	✓								20				18	16	14		11	8		6	4	2	1	X								*C. I.*	2	1	1			2	*Webber & Sons*
24121	*Cross Center Girt*	✓	✓								4				3	2	X																	*" "*	1	1	1	4	11	1	*" " "*
3244	*Head Frame R. H.*										1 6 0				1 5 0	1 4 1	1 3 0	1 2 0	1 1 0	1 0 1		90	80	70	62	52	40	32	30					*" "*	10	1	1	3			*" " "*
3245	*" " L. H.*										1 6 0				1 5 0	1 4 2	1 3 2	1 2 2	1 1 0	1 0 0		90	80	70	60	52	42	32						*" "*	10	1	1	3			*" " "*
11216	*Arch End Long*	✓	✓								24		18				X																	*Bronze*	6	1	1			1	*Stearns & Co.*
11217	*" " Short*	✓	✓								24		18				X																	*" "*	6	1	1			2	*" " "*

A B

FIG. 3. RECORD OF ORDERS AND OF CASTINGS RECEIVED.

American Machinist

Writing for Trade Papers—Apprenticeship Systems.

BY THOS. WATHEY.

How is it that we have no word or contribution from men connected with malleable iron or steel foundries? I am sure there is as good timber, or grist, in those shops as there is in any of the gray-iron foundries.

The other day I met one molder who worked in a malleable foundry, and who used to be on the staff of a local paper. I I asked him if he wouldn't write something for publication. He said that he did not think he could, as there were lots of smart men in the foundry to write up things without him.

I remember the time that I wrote the first little item for the AMERICAN MACHINIST. I did not like to look at it, for fear that someone had been roasting me for not doing it right; but I felt good when I saw it was printed nearly as I wrote it. There are some who claim that they cannot write grammatically and therefore are afraid to let the world see their ignorance; but that is all right in some cases. In law ignorance is not excusable, but in the foundry I think it is, to a certain extent. Now, for instance, there are a great many foundries in the country that make some special line of work. A man or boy goes into the foundry to learn the trade. He is given a job that will probably last him two or three years, and maybe longer—the same thing over and over. When he thinks he has learned the trade (making that one piece) he picks up and goes out on the road to look for a job as a molder. Now this man is excusable for not knowing more about the molding trade than he does, because he has never had a chance to learn. Some time ago a man of this kind came into the shop where I was; he wanted a job as a molder. After a few questions as to where he had worked he was told to take a floor that was pointed out to him and cut up the sand. In due time the foreman came with a pattern and told him to make so many of them.

"Where are the flasks?" he said.

"Why," the foreman said, "we don't roll over the patterns in this shop; we bed them in the floor."

"Oh!" the man said.

In about an hour the foreman came by and saw the man standing as he had left him some time before; so he said, "Well, what is the matter now?"

"Why, I want some flasks to make them in."

The foreman said, "Didn't I tell you that we didn't roll over any patterns in this shop, but bedded them in the floor?"

"Well, but how are you going to roll the ground over?"

This is a sample of some of the molders that are being turned out these days, and then the foundrymen complain because they can't get good molders. But they can't blame anyone else for it; it is the foreman's place to look after the boys, and if they do take interest in their work, to push them along. The boys must be looked after and the men may look after themselves as that is what they are paid for.

I remember well when I went into the foundry first. I was put cleaning castings with a lot more boys, rubbing off the sand with a piece of coke. There were no tumbling barrels at that time, so we had to scrape off all the sand the best way we could. Then I was put on the core bench, then keeping time and weighing castings, then I was raised to the cupola; after being there a while I was given a floor in the foundry. So my experience around the shop had given me a good idea of molding, and it was not long before I could put up a fair day's work.

The general way in which boys are apprenticed now is to give them so much per day—say 50 cents for six months, then 75 cents for the next six months, and a dollar the next six months, and so on until their terms expire. Now, that is all right as to pay, but there is no provision made to keep the boy till his term is up. My idea is to give the boy 40, 65 and 90 cents per day, and if he serves his time faithfully give him in a lump at the end of his time 10 cents per day extra, which would be in the neighborhood of $125 for four years. That would be something worth while waiting for.

On the other hand, if the boy has no inducement, he will naturally serve until he can get another place with more money and then he is off.

Boys don't appear to appreciate the good times they can have now while serving their apprenticeship in comparison with the times when I served my time. When I was sixteen years old, and could do a fair day's work for a boy, I was paid the sum of $2.25 for six days' work, but most of the time we only worked five days a week; that was about $1.88 a week, about the amount the average boy now wants for spending money. With that I had to pay for board, washing and get my clothes.

I had a hard road to travel for some years; so I think those boys that are learning their trade to-day ought to be thankful that they get living wages while they are doing it. My father told me that when he was learning the molding trade he was apprenticed for seven years. He had served six years and a half and got 9 shillings ($2.25) a week. Then he got married and he soon found out that the pay would not last the week out. So he went to London and got a job at $9 a week, but soon the firm heard about it. They sent a policeman to get him back, gave him three months in jail and made him serve out his time after. I don't want such a law as that, but I should like something that would be an inducement for the boys to serve out their time in the one shop and make men of themselves.

Legal Notes.

UNFAIR COMPETITION IN TRADE.

BY LUTHER L. MILLER, OF THE FEDERAL BAR, CHICAGO.

It does not often happen that the defendants in a suit base their defense squarely upon the charges made by the complainant against them, but that is what occurred in a case recently decided in a United States court. Such a course by the defendant would indicate that either he or the complainant is wholly wrong as to his understanding of the law, and in the case mentioned it proved to be the defendants who were in error. They were strong in their convictions, however, for upon being defeated in the Circuit Court they prayed an appeal to the Circuit Court of Appeals, and were again defeated.

The case alluded to was that of the Enterprise Manufacturing Company *versus* Landers *et al.*, and was first tried in the United States Circuit Court for the District of Connecticut and, upon appeal, reviewed in the United States Circuit Court of Appeals of the Second Circuit. The evidence adduced shows that the Enterprise Manufacturing Company and its predecessors, for thirty years past, have made a line of grinding mills for coffee, drugs, etc., which mills are known to the trade as Enterprise Mills, have been extensively sold, and are very popular. Complainant charged defendants with duplicating its entire line of Enterprise mills, not only in mechanical construction, but in color and finish as well. In their answer the defendants admitted that they had done and were doing exactly what the complainant alleged, but claimed that they had an inherent, natural right to do and continue doing what complainant charged them with. In presenting their case the defendants stated that in determining what pattern of mill they would make and place upon the market they judged that it was wiser to offer to the public a mill of a form and appearance such as they were known to like, and as the mills made by complainant evidently met with public favor, both on account of their mechanical efficiency as grinding machines and also on account of their pleasing appearance as articles of furniture, defendants concluded that they could do no better than exactly to copy the line of mills made by complainant. This they accordingly did, using parts of the Enterprise mills as patterns whenever it was convenient or profitable to do so; their only departure from the mills of complainant being an inconspicuous marking of defendants' mills with defendants' trade name and a slight difference in the manner of designating the different sizes. Indeed, the mills produced by defendants were so nearly like those of complainant that a purchaser of one of defendants' mills by mistake sent said mill to complainant for repairs.

Defendants claimed that inasmuch as complainant had no patent upon its mills, it had no right to claim a monopoly in the manufacture and sale of them, that any person whatsoever had a perfect right to duplicate such unpatented mills in every particular, and that in doing so defendants had violated none of the rights of complainant.

In deciding the case the court, after stating the facts as hereinbefore given remarked that the boldness and evident sincerity exhibited by the defendants was a refreshing combination. In cases of unfair competition wherein the defendant is charged with simulating complainant's products, it is usual to find many points of difference between the goods of complainant and those of defendant, and even in cases where simulation was found to have occurred, such simulation usually consists in an identity of or similarity in only the striking features of the original goods or articles. The case under consideration was characterized as unusual, in that defendants "with an air of bold defiance imitated the complainant's goods with minuteness and asserted their right to do so." The Circuit Court and, upon appeal, the Court of Appeals, held that defendants were not at liberty to so dress their product that the trade of complainant should be interfered with, and so that the public should be misled in the purchase of defendants' mills, believing them to be the original Enterprise mills made by the complainant. An injunction was issued against defendants and an accounting awarded.

To show the extent to which courts of equity go in protecting the established trade of a manufacturer against unfair competition, the case of Walter Baker & Co. against W. H. Baker is interesting. The court in that case held that while W. H. Baker had a right to embark in the manufacture of chocolate, he should so dress and advertise his goods that the trade of the old firm of Walter Baker & Co. should not be improperly intereferd with. Defendant was enjoined from using the name "Baker" or "Baker's" alone on labels, wrappers, advertisements, etc., or the name "W. H. Baker & Co.," and was required to make the statement on his labels and wrappers that "W. H. Baker is distinct from the old chocolate manufactory of Walter Baker & Co."

In another case the court held that the rights of the manufacturers of Sapolio were invaded when a merchant delivered an entirely different scouring soap to customers who called for Sapolio. The evidence in this latter case showed that defendant's salesmen, without explanation, would pass out a cake of soap called "Pride of the Kitchen" upon the wrapper of which the name was plainly printed. In this case there was no simulation of packages or goods, but the court held that the act of the salesmen in offering "Pride of the Kitchen" in response to a demand for Sapolio, tho done silently, was a positively unlawful act, to prevent which was the object of the law against unfair competition.

The doctrine of unfair competition in trade is one of the more recent doctrines of equity. It is based upon the principle of justice that forbids a man from palming off his own goods as those of another, whether his misrepresentations are made by word of mouth or more subtly by simulating those features of his competitors' goods by which the consuming public has come to recognize them.

American Manufactures in Russia.

The outbreak of war between Russia and Japan has been a great blow to all branches of industry in the former country, and it is more particularly noticeable because trade had been steadily recovering since the crisis which began some four years ago. One immediate effect of the war throughout the empire is a general restriction of credits, fears being entertained that many of the second-class firms will make the present state of affairs an excuse for not meeting their payments. There is a great lack of confidence all over the country, and on this account most manufacturers prefer to be quiet for the present and await events. Production is being reduced to a great extent, but in spite of this stocks are accumulating, and fears are entertained that many firms will not be able to stand this great strain on their resources. The amount of goods now being sent out of the chief manufacturing centers is but 50 per cent. of that sent out this time last year. The general view is that a good many unsound firms will go under, but that once the war is over there will be a tremendous revival of industry, especially as production is now being restricted to so great an extent. The Siberian Railroad is now occupied almost exclusively by the army, so that very little trade can possibly be done there just now; but still manufactures are being consumed there, and must be replaced sooner or later. The Siberian market is developing rapidly, and it is very likely that one effect of the war will be to give a still greater impetus to that development. The firms that survive the present crisis will have to develop their works soon after peace is restored in order to meet the greater demand that is sure to arise. Firms engaged in supplying machinery and tools, electric plant and apparatus, railway supplies, mill machinery, etc., should be on the alert to secure business when the opportunity arrives. It should be remembered that practically all the money that is being spent on the army is expended within the Russian Empire—up to within recent years England supplied nearly all the mill machinery to Russia. Altho British makers keep up the quality of their supplies and maintain their reputation, yet Germany and the United States are steadily taking more of this trade into their own hands. One reason for the German success is that German is such a well-known language in Russia; another reason, too, is the excellent travelers the German firms send. Unless a man knows eith-

er Russian or German, or, better still, both languages, he is likely to be at a decided disadvantage as compared with his competitors. The Germans and generally, too, the Americans doing business in Russia have the best information about the local standing of individuals, and they are also more willing to do a "risky" business than British firms often care to take up. By risky is meant dealing with people who have but small capital, and who can only buy if allowed very long credit. The obtaining superior information as to financial standing and better commercial travelers are two important factors in extending German and American trade throughout Russia. Curiously enough, the Germans can obtain better information as to their Russian customers' standing from the intelligence bureaus in Berlin than can be had locally in Russia. The long credits given are generally pretty safe ones.

As regards agencies, the American system of forming dépôts of agricultural machinery in Siberia has been productive of excellent results. The success of the system is mainly due to the large permanent stock the American agents keep for display to purchasers; also to the familiarity of the agents with the native language and the local tastes, prejudices and requirements, together with their ability to point out the advantages of their machinery over that of their competitors. The main agents are kept in touch with local demands by numerous sub-agents in various localities. Under the American system there is the advantage to the purchaser of seeing a full line of tools, implements, etc., while the buyers also know how much a machine costs in the actual coin of the realm on the spot; the local manager, owing to information furnished by his sub-agents, is able to judge how much credit he can allow to would-be purchasers. These are briefly the chief points connected with the methods adopted by some United States implement and machinery firms in Siberia, and it would be well if they would pursue the same policy in other foreign markets.

F. C. C.

New Floating Repair Shop for the Navy Yard.

Over at the Brooklyn Navy Yard the keel has just been laid for the new floating repair shop. This shop will not be self-propelling, as was the "Vulcan." She will be a square-toed scow 112 feet long by 36 feet beam. The deck will be flush, except for the necessary skylights and hatches, communicating with the machine shop in her hold.

Her deck equipment will consist of a 10-ton crane at one end. Below, she will have a full complement of machine tools, lathes, planers, drill presses, shapers, etc., a heavy punch and shear. There will also be an electric-light plant, a compressed-air plant, and a forge.

When any of the warships lying in the North River or at Tompkinsville are in need of repairs, the floating shop will be towed alongside.

The shop will also be handy for the Navy Yard itself, for, owing to the peculiar topography of the yard, vessels moored in certain positions are a long way from the shops.

With the floating shop in operation and alongside such ships, the job can in many instances be hoisted on board and finished in less time than it could be hauled to the shop.

The floating shop is available for all but the heaviest repairs and those necessitating the drydocking of ships.

Improved Headstock for Lathes.*

This headstock, shown in the accompanying cuts, the joint invention of Alfred Herbert and Percy Venables, has been designed for use with tools made from the new high-speed cutting steels, by means of which a greater amount of power may be obtained at all spindle speeds than is generally obtainable with headstocks as ordinarily constructed.

In this design the cone pulley is mounted to run freely upon the main spindle of

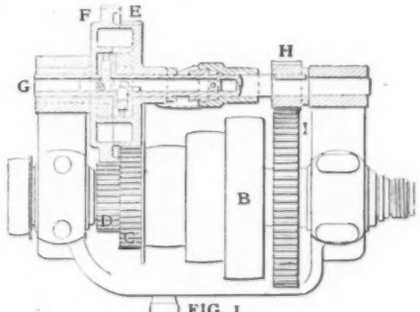


FIG. 1

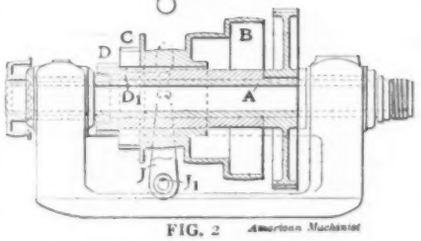


FIG. 2 *American Machinist*

IMPROVED HEADSTOCK FOR LATHES.

the lathe. Motion is transmitted from the cone pulley to the spindle by means of two alternate sets or trains of gearing, either of which causes the spindle to travel at a slower speed than the cone pulley itself. Friction clutches are provided for throwing either set of gearing into operation, but no provision is made for connecting the cone pulley direct to the spindle, as the speeds obtained would be too high to be of use. By this means extra power to any desired extent is obtained by increasing the speed of the cone pulley and arranging the intermediate gearing in a suitable manner. Thus in the case of a headstock in which it is desired to drive the spindle at a maximum speed of 300 revolutions per minute, it is possible to drive the cone pulley at a maximum speed of 600 or more revolutions per minute, and to arrange the set of gearing having the lesser ratio so as to reduce the speed of the spindle to 300 revolutions. The speeds obtained with this ratio of gears in operation would correspond numerically with the speeds obtained in an ordinary headstock with the cone pulley coupled up to the spindle, but would have about twice the power of such a headstock, provided the two cone pulleys and driving belts are identical in size. The second set of gearing is arranged to give speeds corresponding numerically with the speeds obtained in an ordinary headstock with the double gearing in operation, the gear ratio, however, being proportionately increased on account of the high speed of the cone pulley which it is proposed to employ.

In the accompanying illustrations Fig. 1 is a plan, partly in section, of a headstock, and Fig. 2 is a longitudinal vertical section of the same taken thru the spindle. *A* is the main spindle of the lathe, on which runs freely the cone pulley *B* and toothed wheels *C*, *D*. It will be noticed that the toothed wheel *D* is cut on the end of the sleeve *D*, running loosely on the spindle *A*, and that the toothed wheel *C* and cone pulley *B* are keyed to the sleeve D_1. The toothed wheels *C* and *D* gear respectively with the toothed wheels *E* and *F*, mounted loosely on countershaft *G*, each of the toothed wheels *E* and *F* being provided with a clutch, by means of which either may be clutched to the countershaft, the other rotating freely around the exterior of its clutch. On the other end of this countershaft is keyed the pinion *H* gearing with the toothed wheel *I* keyed to the main spindle *A*. The clutches are controlled by the clutch lever *J*, mounted on one end of the cross shaft J_1.

*From the *Mechanical Engineer*.

There is to be held in Vienna, Austria, an exhibition of American machinery as soon after the close of the St. Louis exhibition as possible. This exhibition has been planned and is to be under the direct management of the Austrian Government; they have given the use of their exhibition buildings; no customs duties will be charged on exhibits and liberal reductions in freight rates have been arranged. The exhibition is to encourage and interest manufacturers in Austria and the surrounding countries. A committee is formed to properly conduct the exhibition and a sub-committee to sell and develop a market for product. For the latter a charge of 10 per cent. commission will be made on all sales made thru this exhibition. Special Commissioner J. H. Sears, Box 3156, Boston, Mass., will furnish details.

Twenty years ago the sawmill men in Maine were glad to give away their sawdust and often had difficulty in so disposing of it. To-day it sells for $1 a cord, and buyers are always waiting for it. It still seems to be only good to burn, and has no value as a fertilizer.

Molding a Crank-Disk—Cooling the Casting to Prevent Shrinkage Strains—Mixing Foundry Iron.

BY R. H. PALMER.

Fig. 1 shows the face of a pattern for a crank disk, and Fig. 2 is a side elevation of the disk in its molding position. The pattern is laid on a mold-board, cope side down, the drag is placed over it and rammed up, and the mold is parted and finished, these operations calling for no detailed description.

The mold in finishing is nailed all over the face at *C*, Fig. 4, the nail heads being left even with the face of the mold. This is done as it is found that there is a tendency for the face of the mold to be drawn down at this point when pouring. The cores are now set, and the mold is closed.

It will be seen that the mold is poured thru the center core *A*, Fig. 4, near the face, but the gates entering the mold thru the core are kept up from the face far enough to prevent the inrush of iron from cutting or washing the face of the mold; the surface of the mold is very soon covered up to the gates and then it is iron entering against iron, thus having a tendency to keep out dirt and produce a cleaner casting. The casting is pumped or churned thru riser *B*, Fig. 4. Fig. 5 is top view of the flask ready for pouring with the exception of a clamping flask covering riser *B* and the weighting of the runner box over the center.

The molding is simple, but the treatment of the casting after pouring is of the utmost importance. The casting at the rim is, say, 1¼ inches thick, and the plate 1⅜ inches. These surround what in reality are the crank and the counterbalance, thus bringing a mass of iron of much greater weight in the center of a plate and inside a rim of iron which would naturally cool faster, thus bringing a heavy strain on the casting in cooling were it simply poured and then left to cool off as it might.

When the casting is finished in the machine shop it has to be forced on to the main shaft of the engine under heavy pressure, and all this before the working strain of the engine comes upon it. Hence, that it may be able to stand these strains which it is to be subjected to, it is of the utmost importance that the casting shall cool as evenly as possible, so that there may be no internal strains in addition to those which it must legitimately encounter.

The molder, as soon as the iron in the casting is solid enough, takes off his cope, uncovers the counterbalance and hub and digs out the core in the center and in the crank-pin hub. He then forms pockets on each side of the hub, as shown at *D D*, and into these he pours melted iron and covers it and the rim with sand, leaving the hub and the counterbalance uncovered.

Castings are often wanted which are thus out of proportion as to their cooling opportunities, or where some parts are heavy and other parts are light, and then the question is sometimes raised as to the advisability of changing the pattern so that the casting will still serve its purpose all right, but will also cool more evenly and avoid unnecessary internal strains. Changes are often made in the forms of castings to meet the difficulties of the machine shop, but in this other case many will say, "Oh, give it to the molder and he will take care of that," little realizing that while they are ready enough to belittle and berate the foundryman for any failures, they are still paying him a high compliment when they leave to him the solving of some of these important problems on which depend the usefulness of the casting as a part of the machine, and the fitness of the machine, as a whole, to stand the strains and do its allotted work.

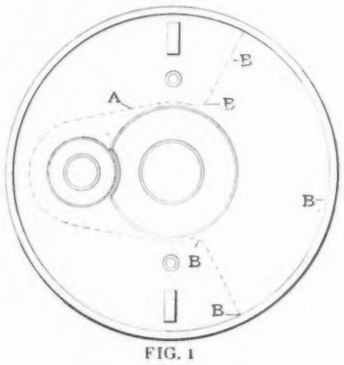


FIG. 1

FIG. 2

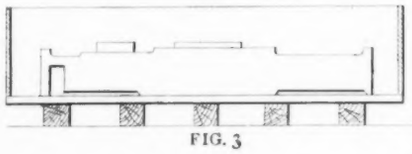


FIG. 3

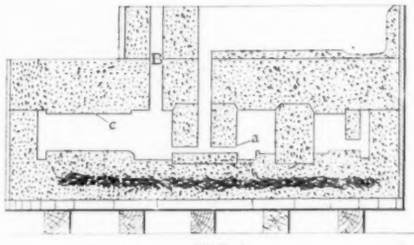


FIG. 4

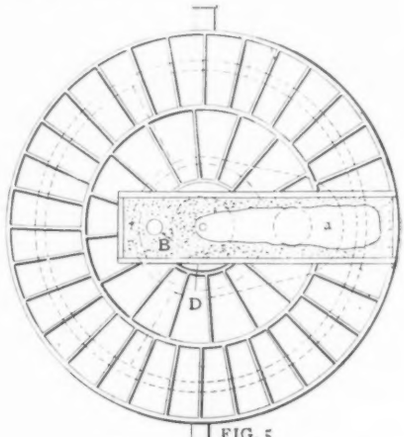


FIG. 5

FIG. 6

American Machinist

MOLDING A CRANK DISK.

His ways of treating these problems are varied, according to the size or other particulars of the casting to be produced. He employs either heat or cold, as the case may require. He uncovers the heavy parts, keeps the lighter parts covered, and adds heat to the lightest parts as I have described. If some parts are too heavy, and the atmosphere will not do the cooling fast enough, he uses water. If, as in some cases, the part must cool quickly and water cannot be used, he may cool the heavier part by chills.

Some years ago in some locomotive works foundries the driving wheels were cast with two counterbalances in them, a space being left between the two for the third one to be bolted in. After pouring the wheel, the cope would be removed, and hubs and counterbalances were uncovered, cores dug out, sand dammed up around the counterbalances, and they and the hubs would be cooled with water until they were the color of the rim, and those wheels always stood the working strain. One day an apprentice cooled one too fast and cracked it. He caught a blessing.

The wheels had always been cast with cores in the spokes running thru to the center core, and when the wheels were set out of doors any water would run thru the spokes as the wheels stood on their rims. The wheel pattern was changed, the hub was cast solid and the spoke cores stopped short of the center core. About twenty of them were stood on the rims under the eaves of a building. They filled with water, and one cold night they froze up, and were found with cracked arms, and the apprentice boy has often wondered who caught the blessing then.

Afterward they were cast with three, and sometimes four counterbalances, and the rim was cut each side of the counterbalance. After pouring the hub the counterbalances were uncovered and the wheels came out all right.

In casting pulleys with a heavy hub the rim and arms are kept covered, but the hub is uncovered and the core is dug out

to cool it faster. A balance wheel may be cast with a heavy rim, which will keep hot longer than the center, calling for the rim to be uncovered. In many of the fly-wheels cast for stationary engines the hub is split, and later bolted together, while the rim is cast solid, so that as the wheel cools off the arms and hub may push in to avoid straining. Lathe beds often rise or spring up in cooling if, say, 14 feet in length, and they are molded with ends down about the amount they rise. In lathe beds 30 feet in length the ends will stay down, but then the center will come up, so then the center is molded down. Columns or pilasters having sides and top or front with no back or bottom, have thin ends which come up when casting, and they are molded with the ends down so that they may straighten themselves.

If a foundryman is casting a front for, say, a five- or ten-story building, it is of the utmost importance that the mixtures of iron used shall have a uniform shrinkage. In these days, when he may get the chemical analysis of every car of pig iron received, his task is somewhat lightened, if he understands its use, as by varying his mixtures to meet the requirements of the work and keeping careful watch of the amount of shrinkage of a certain mixture, also by physical tests, he soon learns what mixtures are best adapted to his needs. He sees, however, that the car of 2X iron to-day differs from that of yesterday, but by careful watching it will not be a great while before he will know how to change his mixture to meet the change in his iron.

To-day the needs of the foundry are more clearly understood, as well as the difficulties the foundryman contends with, and it is because such papers as the AMERICAN MACHINIST have given place in their columns to the foundry. Within a short time there have appeared in its columns descriptions of different styles of foundry buildings, also of general foundry appliances and how they have been arranged in the foundry to do the work, also descriptions of different arrangements for the comfort and health of the men. It has helped the employer to thus see the needs of the foundry. It has helped the employee also to see in many cases how his employer has taken into consideration his health and comfort and has given him ideas of how work was done in other shops. The employer who was fast enough a few years ago to say, "Anything is good enough for a foundry and foundrymen," has changed his story. The employee who thought an employer wanted all there was seldom peeps. Each understands the other better because an open explanation of the difficulties met and conquered helps to augment the respect and confidence which each may have for and in the other.

Ex-Gov. A. B. Cornell, who died recently, is said to have been the first telegraph operator to take messages by sound. He began to operate at Troy, N. Y., in 1846. The precise date of the beginning of sound telegraphy is not fixed, but it was several years later.

Trade Conditions in Japan.

In a recent letter from Chas. A. Francis, M. M., Tokyo Koto Kogyo Gakko, Tokyo, Japan, he says:

Thinking you and the readers of the AMERICAN MACHINIST might be interested in knowing something about the industrial conditions of this country, I send you a few figures which show that while the country is engaged in war, the outcome of which means her existence as a nation, her industrial interests are not allowed to remain stagnant, but are being steadily pushed forward with vigor, regardless of the war.

We who are in this country at the present time believe that when the war is over, everything pertaining to mechanical and industrial lines will receive more attention than ever.

These figures which I send you do not represent the complete list, but are the most essential items, collected from the Inland Office reports of August, which I have had translated for your paper.

All of these companies are new, and all organized in the month of August, as before stated, with perhaps three or four which have been reorganized, one of which is the Machine Manufacturing Company, with a capital of 1,000,000 yen ($500,000). This company has been in existence for some years, but was reorganized during the last month. In the list of banking, would state that this amount is put up by about nine different companies, and the capital invested by the importing companies and amounting to 546,000 yen is the sum put up by twenty companies, ranging from 10,000 yen, the smallest, to 60,000 yen, the largest amount.

	Yen.
Asphalt	250,000
Banking	255,000
Brick making	50,000
Copper refining	250,000
Electric lighting	40,000
Glass manufacturing	20,000
Ice making	20,000
Importers	546,000
Metal mining	20,000
Machinery manufacturing	1,000,000
Metal manufacturing (precious metals)	30,000
Oil wells and refineries	600,000
Paper mills	100,000
Paper box manufacturing	25,000
Ship machinery and repairing	10,000
Soap manufacturing	10,000
Silk manufacturing	97,000
Sulfur refining	100,000

Note—One yen equals 49¼ cents in United States money at present bank exchange here.

Regarding the importing business for August, cotton and wool occupied the larger part (so it is reported).

I think that the foregoing figures show a very good report, when you consider that the country is at war.

Quick Work In Replacing a Large Pulley.

On Thursday, October 6, the gray-iron main drive pulley, 112 inches diameter, 37-inch face, in the plant of the Lafayette Box Board & Paper Company, Lafayette, Ind., went to pieces. The officials of the company, appreciating the length of time required to get an iron pulley of this size in place, sent their men home, and announced a thirty-day shutdown, not knowing that a wooden pulley of this size, and to carry 600 horse-power, could be built; but later in the day President Bauer, of the paper company, telephoned the Reeves Pulley Company, at Columbus, concerning the trouble, and was assured that it could furnish him a pulley of the size designated and guaranteed to carry the load, and the order was placed.

Work was commenced on the pulley Friday morning at 7 o'clock, and within eighteen working hours it was completed and *en route* to its destination. The pulley, accompanied by superintendent W. S. Jones, of the Reeves Company, was taken by Saturday's midnight Pennsylvania express to Indianapolis, where the Chicago fast express of the Big Four was held one hour, in order that the pulley might be transferred, and this train in turn delivered it at Lafayette at 3 o'clock Sunday morning. The pulley was here met by a corps of workmen and Superintendent Wilson, who immediately transferred it to the paper plant, where, under the direction of Mr. Jones, the installation was completed Sunday afternoon, and on Monday morning at 6 o'clock the mill started as usual.

At the opening meeting of the Iron and Steel Institute, holding its sessions in this city as we go to press, Andrew Carnegie, representing the visitors as their president, spoke as follows of the growth of our industries: "Upon our last visit, the Institute was amazed at your extraordinary development, but they find to-day that rapid as that had been, it has proceeded at even quicker pace since then. The figures are positively staggering. Your product of pig iron the year we visited you, 1890, was 9,200,000 tons; in 1903 it was over 18,000,000 tons. Thus, in thirteen years, it had doubled. In Bessemer steel production much more than doubled, and in open-hearth steel the increase is more than elevenfold—from half a million tons in 1890 to nearly six millions in 1903. Your export trade in manufactures has increased nearly threefold. In the decade 1890 to 1900 you added 13,500,000 to your population, and the national wealth increased from sixty-five to ninety-four thousand millions of dollars. No wonder we come to see for ourselves and to study such portentous growth." It is a remarkable coincidence that on the previous visit of the Institute Andrew Carnegie delivered the address of welcome.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

World Building, New York.

Also Published at 6 Bouverie Street, London, E. C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, World Bldg., New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe; Twenty-five Shillings there. No back numbers beyond current year. For sale by all newsdealers generally.

The AMERICAN MACHINIST CO., LTD., 6 Bouverie St., London, E. C, will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 25 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Of this issue of the AMERICAN MACHINIST *17,200 copies are printed. Total for* 1904, *so far,* 871,750. *None sent regularly free. None taken back from news-stands. No back numbers beyond current year.*

Contents.

	PAGE
The Geometry of the Square-Thread Screw	1421
What is Useless Knowledge?	1424
Industrial Education in Germany—VIII	1424
An Electrically Driven, Portable, Radial Drill	1426
Balancing a Valve and Diafram	1427
What a Circular Saw Can Do	1428
Alcohol for Motors—III	1428
Letters from Practical Men: A Job of Loam Molding....Hardening Drill-Jig Bushings....A Milling Machine Vise....Chuck for Small Dies—A Die Dividing Attachment	1431-1439
A Simple Foundry Order System	14,0
Writing for Trade Papers—Apprenticeship Systems	1441
Legal Notes	1442
American Manufactures in Russia	1442
New Floating Repair Shop for the Navy Yard	1443
Improved Headstock for Lathes	1443
Molding a Crank-Disk—Cooling the Casting to Prevent Shrinkage Strains—Mixing Foundry Iron	1444
Trade Conditions in Japan	1445
Quick Work in Replacing a Large Fulley	1445
Changed Conditions in England	1446
An Incomplete Investigation	1446
The Private Car Abuse	1446
Some New Things	1447
Technical Publications	1450
Personal	1450
Obituary	1450

Changed Conditions in England.

The Engineer, of London, for October 7 has a striking editorial on the decay of the Royal Agricultural Society which is an indication of the vast industrial changes which have come over England during the past sixty years. The Society was organized in 1838 and within a year had 1,100 members. Beginning with 1839 its famous shows have been held annually with the single exception of 1866, when the exhibition was omitted because of the then prevailing cattle plague. Until recently these shows were events of national importance and, tho held at heavy expense, resulted in profit.

During the lifetime of the Society and under its patronage practically all of the present line of agricultural machinery has been developed. The trials of these machines under the auspices of the Society have had the most far-reaching effects, the trials of portable agricultural engines especially being historic. Under the stimulus of the competitive trials of these engines, they were developed to a degree of perfection which was probably unmatched elsewhere. Their culmination was witnessed in 1872 when a record of a little less than three pounds of coal per brake horse-power per hour for single cylinder non-condensing engines of small size was established, and this is yet to be beaten.

Of late years the exhibitions have been of diminishing interest and have resulted in heavy losses, one reason being that the record of great advancement in agricultural machinery seems to be closed. At any rate, improvement in the center of attraction of the shows—the portable farm engine—has ceased and in the whole line of agricultural machinery nothing of special merit or commanding novelty has been exhibited or made the subject of competition for several years.

Of still greater importance, however, is the change of England from an agricultural to a manufacturing nation. At the organization of the Society agriculture was a principal factor in the prosperity of the nation, but it has now dropped to the third or fourth place.

We have never had a similar organization in this country comparable in influence with the Royal Agricultural Society, and it is not easy for an American to understand its unique influence in England. It seems especially strange that an agricultural society should exercise the influence which this one has on engineering. No meeting of any engineering society was reported at greater length in the English engineering press than were the Royal Agricultural Society's shows, which, thru their trials of machinery, were of recognized engineering importance.

The Engineer concludes its editorial by urging that the work of the Society is done and that it disband, "an honorable death being more consonant with the fine traditions of the Society than an ignoble existence."

An Incomplete Investigation.

The report of the national commission appointed to investigate the "Slocum" disaster and the immediate action of President Roosevelt upon it dismissing Supervising Inspector Redie of the Second District and Local Inspectors Dumont and Barrett and recommending necessary changes in existing laws is to be commended and must be accepted as all that seems now possible to be done in the case. The punishment for the atrocious crime for which these men were largely responsible is so absurdly inadequate that it is not worth considering, and the only thing of importance is the bearing of the report upon our future safety. Unfortunately, the incompetence and corruption reported by the commissioners is not a new discovery. A year and a half ago, in March, 1903, the AMERICAN MACHINIST, speaking of the steamboat inspection service in connection with other matters, said editorially: "It has been shown conclusively that the inspection of the hulls, boilers and engines has been very inefficiently done and that there has been more or less corruption in connection with the work. It has been demonstrated that vessels have been allowed to carry passengers under conditions distinctly prohibited by the law because careless, incompetent, or corrupt inspectors allowed such laws to be violated, and shipbuilders and owners have not hesitated to take advantage of this condition of affairs. *If there had been a great disaster with very great loss of life, then there would have been a revival of public interest in rigid inspection and probably an improvement in the inspection as a result.*" What led to this writing was the fact that Supervising Inspector General James A. Dumont had then recently been removed from his responsible office on account of incompetence and corruption. The most astounding thing, which the report above referred to says nothing about, is that this man Dumont was thereafter appointed to a position scarcely inferior in responsibility, and that under his administration, and by reason largely of the method of his administration, this awful thing came upon the community. This fact was certainly within the knowledge of the investigating committee and its failure to bring it out in the report leaves the report incomplete and so far unsatisfactory. To us the possibility of the reappointment of Dumont and such as he, and the actual reappointment of him with his record in full sight is suggestive of nothing but hopelessness as to our future safety. There is large opportunity for a supplementary report reaching higher up.

The Private Car Abuse.

We referred last week to the private car abuse which has grown to such enormous proportions and which affects so many people. Concerning this question, J. W. Midgley, who has for some years taken a prominent part in certain lines of

railroad work and has especially devoted his attention to the private car matter, writes a letter to the *New York Times*, in which he sets forth the attitude of railroad officials with regard to this matter. According to him the roads make no money out of the traffic and are practically compelled to accede to the private (refrigerator) car owners' terms because if an official declines them or even shows any activity in an effort to bring about a correction of the abuse, he is immediately blacklisted, his road boycotted and he in danger of losing his place for allowing business to fall off or be diverted to other roads. The two statements do not seem quite consistent, and one wonders just why the loss of business that is unprofitable should endanger the position of a railroad official responsible for losing it. According to Mr. Midgley, however, "no officer of a road dare speak his mind on that subject, nor are they willing to meet openly for such purpose, because someone would surely inform the packers of what was contemplated, and the latter would defeat the efforts by diverting their traffic from those roads which were supposed to be taking the initiative."

Mr. Midgley himself seems to have been acting for the roads and to have brought about the recent investigation by the Interstate Commerce Commission; he himself being, like a walking delegate, in such position that he cannot be discharged or in any way reached by those against whom his operations are directed. He complains also of some prominent roads which "would be benefited beyond estimation if my (his) efforts should be successful," yet these roads "have contributed literally nothing toward my (his) support." In the meantime these railroads, who put themselves in the attitude of men who are sometimes called scabs, are with the others, we presume, making use of the lesson taught them by the packers and are applying it in other directions; to postal cars, for instance, which they (the roads) own and operate for the Post Office Department and get payment for doing it that is, to put it mildly, extravagant and that goes far to explain the ever-recurring deficiencies in that department and its inability to improve the service as the business and other interests of the country demand. Thus the public suffers at both ends of the line, so to speak, and it all results from the monopoly of highways vitally necessary to modern conditions of existence and the struggles of various "interests" to control these monopolies or to participate in the fruits thereof.

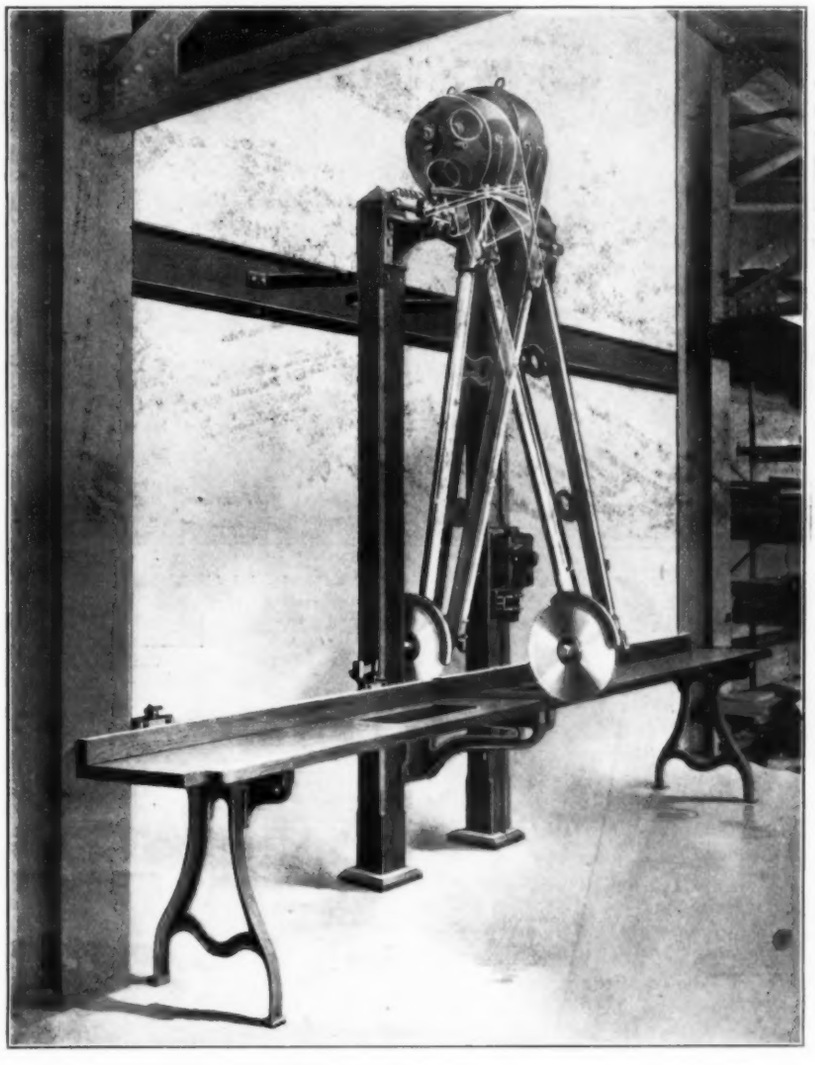
We hope at least that every business man and manufacturer engaged in legitimate business, most of whom are engaged in severe competition, will see clearly the difference between their own business and the other kind and refuse to be classed with the other kind.

The erection of the eight granite columns for the Cathedral of St. John the Divine in this city is now approaching completion. It was proposed, it will be remembered, that these columns should be monoliths, and the work had progressed so far that more than one column was partially turned and one was almost entirely finished only to break in two before being removed from the lathe. It must be confessed that the columns as they stand, notwithstanding the diameter of nearly six feet, are pretty slim-looking affairs, and if they could have been entirely finished in the lathe would have been very likely to have broken in transportation. Finally making each in two pieces vastly reduced the difficulties and doubtless also the cost, while the result appears to be in every way as satisfactory. The columns, however, will not be as valuable to the antiquarians of A. D. 3000. The question as to the mechanical ability to turn the monoliths and to deliver them from the lathe in a finished condition was by no means settled in the negative in this case. The job simply did not warrant the expenditure which would have been necessary in the way of experimenting and the preparing of the necessary appliances.

Some New Things.

MOTOR-DRIVEN SWING SAW.

A very desirable location for a driving motor was secured in the swing saw outfit shown in the accompanying illustration by slightly modifying the yoke casting of a standard M. B. Tidey swing saw. The motor, as shown mounted above and attached to the frame, with which it swings, is of the form I semi-enclosed, shunt-wound type, manufactured by the Crocker-Wheeler Company. When run at full speed, 1,170 revolutions per minute, 4 horsepower is developed by the motor which drives the 18-inch saw, thru a belt connection, at approximately 2,500 revolutions per minute. The motor is mounted so that its center of gravity is one inch forward of the center line of the trunnions on which the frame swings. The result is that when not in use the saw swings back out of the way, thus eliminating the use of the customary counterweight.



MOTOR-DRIVEN SWING SAW.

The saw is shown in two positions: resting against a stop clear of the table (its ordinary position when not in use), and swung out to its maximum reach. These illustrate the extent of its range.

The bench is of hardwood supported at the ends by gray-iron legs and at the center by a bracket. It is graduated in inches, and has two adjustable stops to facilitate the cutting of lengths in duplicate.

The equipment, controlled by a starter shown mounted on the right-hand upright, at the operator's constant command, makes a very compact and convenient unit.

A NOVEL REVOLVING CYLINDER GASOLINE ENGINE.

The engine here shown is not a rotary engine and has not the inevitable objections which accompany devices of that class. It has *bona fide* cylinders with reciprocating pistons which connect to a crank, the peculiar feature of this engine being that the crank is stationary and that the cylinders are driven around it by the thrust of the pistons upon the crank-pin. This arrangement has been adopted not to produce a freak engine, but to secure desirable practical results. The engine has been designed principally for propelling automobiles and is here shown as applied to that service, but it will be seen to be applicable to other uses. Perhaps the most desirable result secured by this engine is the perfect balance of the revolving parts. There are three cylinders, each a complete unit with one-third of a crank case cast as a part of it, and the cylinders are bolted together and also bolted to top and bottom cast-steel flanges which have bronze bushings forming bearings which fit the vertical and stationary crankshaft.

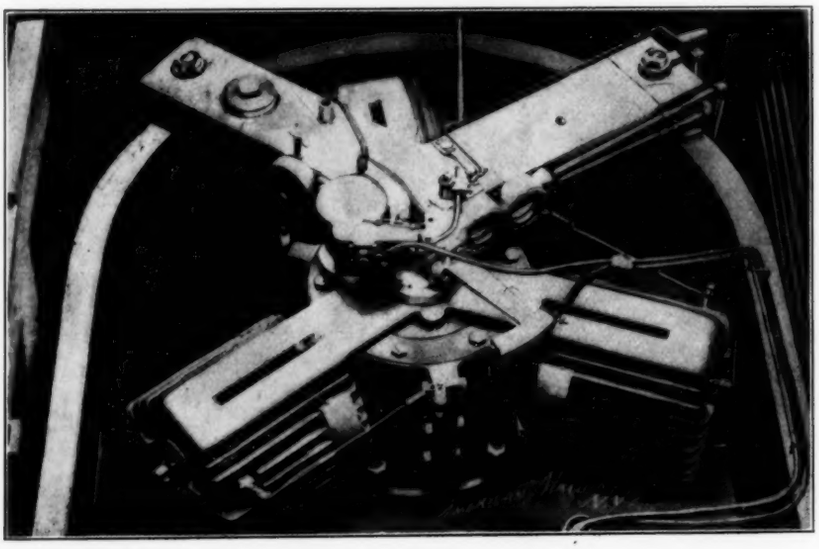


FIG. 1. ADAMS-FARWELL GASOLINE ENGINE IN AN AUTOMOBILE.

The symmetrical arrangement of the three cylinders, all revolving around a common axis, makes the balancing a simple matter and the smooth running naturally follows. The three similar pistons while in the process of revolution work lengthwise of the cylinders and thereby do their driving. At the same time they are still practically equidistant from the center of the crank-pin and so they are constantly balanced except for the slight variations of radial distance caused by the angularity of the connecting rods. The cylinders, in fact, revolve around one fixed center and the pistons revolve around another fixed center, and the absence of vibration therefore to be expected is actually realized in practise. The weight of the combined cylinders, the principal part of the entire engine, enables them to perform the additional function of an effective flywheel.

The action of the exploding charge is practically the same in this engine as in those of the ordinary type except for the smooth running caused by the variable compression control. A single valve-operating cam opens both inlet and exhaust valves. Auxiliary exhaust ports reduce the pressure to that of the atmosphere before the exhaust valve in the cylinder head is open. The escaping gases are therefore comparatively cool. The cylinders are cast with thin longitudinal ribs which give a large radiating surface and thus effectually cool them, the cooling being greatly facilitated of course by the fact that the rapidly revolving cylinders constitute a fan; no other being needed nor any cooling water pumps, etc.

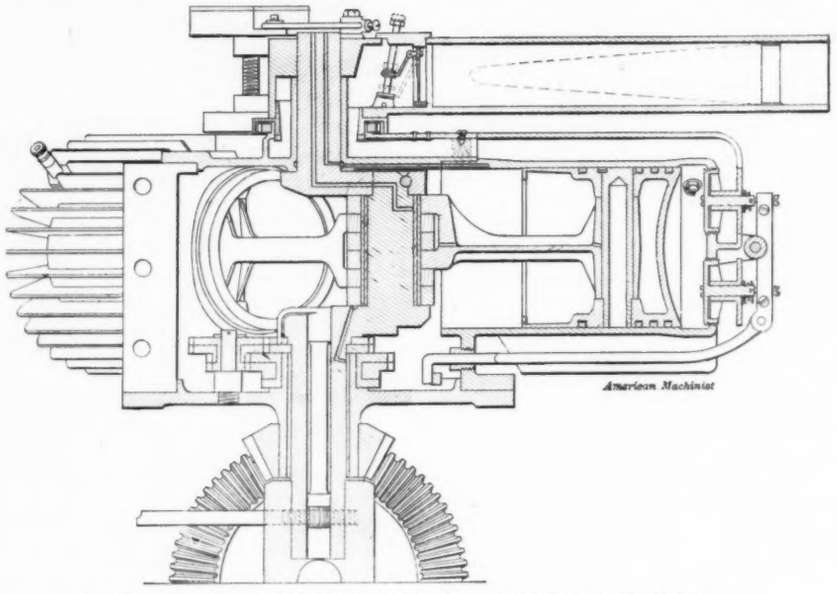


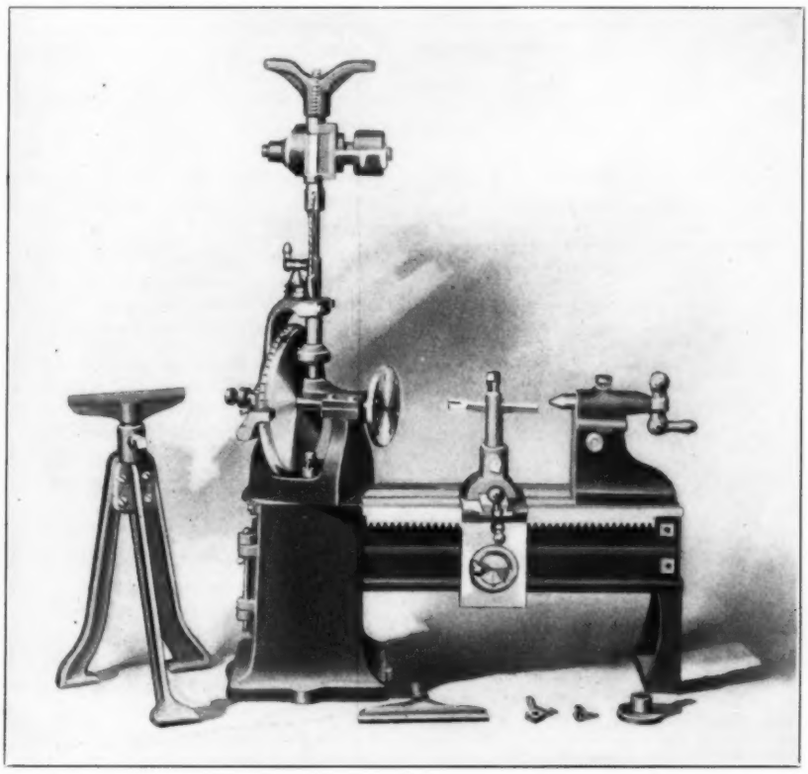
FIG. 2. VERTICAL SECTION OF ADAMS-FARWELL GASOLINE ENGINE.

The speed of the motor is controlled by a variable compression system which allows that part of a charge which is not needed for power to escape into a chamber from whence it is taken by the next cylinder. Thus no part of a charge is wasted, nor is there any waste by late ignition and consequently partially burned charges. When the maximum power is required the inlet valve is closed at the end of the suction stroke and the full charge is compressed to about 95 pounds. When minimum power is required the inlet valve is not closed until the completion of the compression stroke, and a very small part of the charge is retained and ignited at atmospheric pressure, giving a light explosion. There are many other details of construction and operation which have to do with the special adaptation of this engine to automobile service which it is not necessary to call attention to here. The half-tone, Fig. 1, shows the engine as actually installed in a vehicle, and Fig. 2 is a vertical section of the engine which shows clearly its principal features. The bevel pinion is attached to the cylinder case and the bevel gear is on the cross shaft or axle. The fact that the cylinders perform the function of a flywheel, and that all the parts required for cooling in the ordinary way are also dispensed with, very much reduces the weight of the engine for a given power, and we can testify from observation of its working that for automobile purposes it is remarkably flexible with regard to the amount of power developed under control of the operator, the system of control permitting a stroke of maximum power to immediately succeed one of minimum power, or *vice versa*, as may be required by the exigencies of driving. The

engine is known as the Adams-Farwell gasoline engine, and is built by The Adams Company, Dubuque, Iowa.

A NEW UNIVERSAL LATHE FOR THE PATTERN SHOP.

The half-tone shows a wood turner's lathe with an unusual number of original



A NEW UNIVERSAL PATTERNMAKER'S LATHE.

features, most of which are sufficiently evident without explanation. The headstock is swiveled, and instead of the usual cone pulley the flat disk and familiar variable friction drive is employed. The center of the vertical shaft coincides with

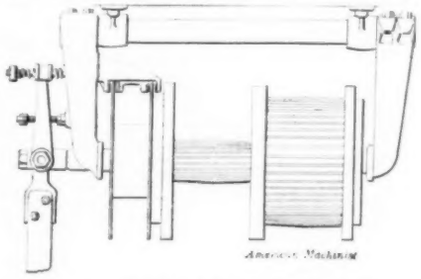


FIG. 1. FRONT VIEW OF SPEED JACK.

the center upon which the headstock swivels, so that whatever the working angle the drive is not affected. Helical gears are employed in the countershaft to drive from the horizontal to the vertical, and the shaft leading down to the lathe has universal joints at each end, so that no accuracy is required in setting. The edge of the friction disk in the headstock, 24 inches in diameter, is graduated for dividing or laying out work that may be either chucked or mounted on the centers. There is a set-over tailstock, the carriage has cross-feed and is moved along the ways by rack and pinion. Either turning tools or a rest may be secured in the tool-holder. Straight or taper work may be turned on the centers and chucked work may be turned to any angle either outside or inside. Large work may of course be turned on the back end of the spindle with the floor standard for the rest, as shown. The lathe is built by the Diamond Clamp & Flask Company, Richmond, Ind.

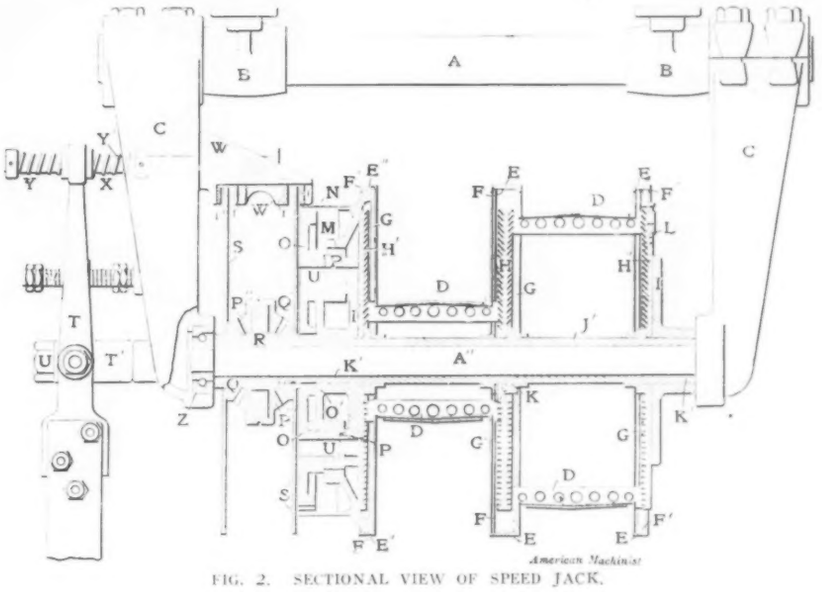


FIG. 2. SECTIONAL VIEW OF SPEED JACK.

THE SPEED JACK.

The Reed-Morrill Electric Company, 1035 Ridge avenue, Philadelphia, has brought out a speed-changing device. Fig. 1 shows a front view of the speed jack, suspended from the ceiling. The jack consists primarily of two expansible pulleys hung upon a swinging frame placed between the line shaft and the machine countershaft. One of these pulleys is a driver and the other driven. As the one pulley increases in diameter the other decreases and *vice versa;* the swinging frame allowing the belts to adjust themselves to the varying diameters of the pulleys. Fig. 2 is a sectional view of the device. When the shifter *T* is moved to the

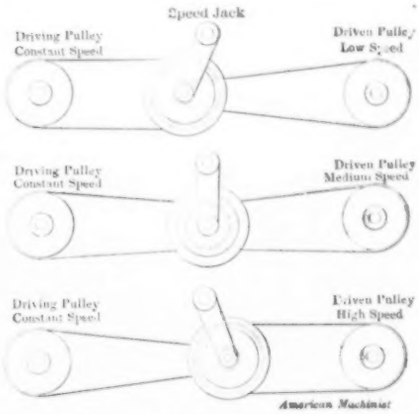


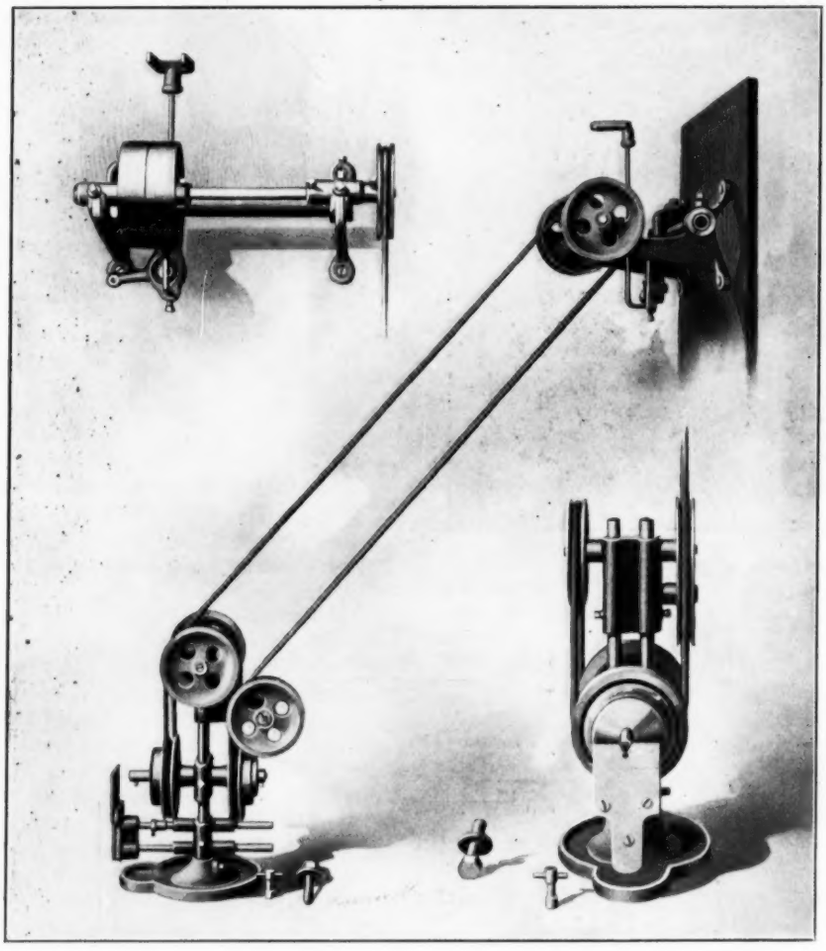
FIG. 3. ROCKING SHAFT IN THREE POSITIONS.

left the face *f'* of the movable clutch jaw *H'* is pressed against the outer clutch disk S, gripping it and preventing rotation. This, thru the train of spur and bevel gears, gives relative motion in one direction to the guide plates with reference to the scrolls, the scrolls all being pinned to the shaft, and the guide-plates all being movable and connected thru the gears only to the shaft. Moving the shifter in the opposite direction grips the inner clutch disk *S'*, causing relative motion of the guide plates and scrolls in the opposite direction. This relative motion of the scrolls and guide-plates causes one set of slats or rim sections to move out-

ward from the shaft, and the other set to move inward toward the shaft. The simultaneous expansion of one pulley and contraction of the other maintain an equal tension on the belts, one of which goes to the driving pulley and the other to the machine driven or to the countershaft. Fig. 3 shows the rocking shaft in three positions. The speed jack is also adaptable to vertical belts, shifting belts and open and cross belts.

THE BRIDGEPORT TAPPING MACHINE.

The little machine here shown is an outgrowth and a survival of the bicycle boom. There was once upon a time the necessity for a quick method of tapping



THE BRIDGEPORT TAPPING MACHINE.

large quantities of bicycle nipples, and the progenitor of the present machine was devised for the purpose. With it a boy could tap 600 nipples per hour. The machine has lately been improved and perfected and placed on the market for a variety of small work. The countershaft has tight and loose pulleys with a shipper operated by a treadle. The single round belt gives the motion in both directions, the tapping spindle rotating in either direction according to the thrust upon it. The frictions are of mahogany running against cast iron, and they are so sensitive that with proper care the smallest tap may be used tapping into the bottom of a blind hole without breaking. There is sufficient power to drive ¼-inch taps. Attention is called to the grooving of the pulleys for the round belt. The pulleys which do the driving are V-grooved at the angle which has by experience been found to be best, while the idler pulleys have round grooves. The countershaft is made, if required, with two speeds. Manufactured by the Bridgeport Motor Company, Inc., Bridgeport, Conn.

The business of trading in pig-iron warrants is soon to begin at the New York Produce Exchange. The operation of the proposed system is thus explained by J. F. Parker, chairman of the pig-iron committee of the Exchange:

"The idea in brief is that the American Pig Iron Storage Warrant Company will issue their warrants for pig iron stored in their care by the manufacturers. These warrants are to be registered with the Central Trust Company and may be deposited in the Farmers' Loan & Trust Company, who will issue certificates for the same. It is these certificates which will form the basis of trading on the Exchange. When the purchaser requires a delivery of the iron respresented by a certificate he takes his certificate to the Farmers' Loan & Trust Company, who stamps it 'for cancellation' and signs a delivery order which the warrant company issues. One great advantage to the trade will be that the trust company will report to the Committee on Pig Iron each day the places where the iron represented by the warrants that are out is stored, and the purchaser can take his certificate and have it exchanged for a delivery order in any of these places he may desire by adjusting the difference to make his iron equal the value of No. 2 foundry pig iron stored in a New York warehouse."

Buyers will thus be able to secure prompt delivery at other points by adjusting prices to the basis of No. 2 foundry iron at New York. Forms of contracts and rules defining the routine to be followed in the various transactions have been prepared and were recently published very fully in *The Journal of Commerce* of this city.

Technical Publications.

"Alternating Current Engineering." By E. B. Raymond. 231 5½x7½-inch pages, with 101 illustrations. The D. Van Nostrand Company, New York. Price, $2.00.

The author of this book, who is connected with the testing department of the General Electric Company, presents a general treatise in alternating current engineering in, comparatively speaking, very simple language. Those who have been dismayed by the formidable mathematics of most books on this branch of electricity but who are able to read mathematics of a milder type will find here a treatise from which they can learn both the action of alternating current machinery and the more important calculations connected therewith.

Personal.

A. S. E. Ackermann, consulting, civil and mechanical engineer, has removed his offices in London to 25 Victoria street, Westminster.

Obituary.

Elkanah Lane, president of the Lane Tool Company, Cleveland, Ohio, makers of steel hammers, died October 14, sixty-nine years old. The company was founded in 1890.

Business Items.

The Niles-Bement-Pond Company has been awarded the Grand Prize in Group 65 at the St. Louis Exposition. The Pratt & Whitney Company has been awarded the Grand Prize in Group 65 and the Gold Medal in Group 66.

A Grand Prize has been awarded by the Louisiana Purchase Exposition to the Laidlaw-Dunn-Gordon Company, of Cincinnati, who installed the two large compressors located in Block 33 of Machinery Building. One of the machines has a capacity of 1,300 cubic feet of free air per minute when running at 125 revolutions, and is used to supply the general compressed air requirements of the exposition, while the other is capable of furnishing 530 cubic feet and supplies the transportation exhibits.

The Chicago agency of the Firth-Sterling

Steel Company has secured for another year the services of C. C. Worrall and F. N. Mead, the two original blue chip men. Mr. Mead will continue selling Firth-Sterling tool steel in northern Illinois, Wisconsin, Iowa, Minnesota and Montana. Mr. Worrall will sell in Nashville, Tenn.; Louisville, Ky.; Indianapolis, Richmond and other cities in southern Indiana. The Firth-Sterling tool steel selling contest for 1904 will be won by W. C. Royce, of Cleveland, Ohio, unless all signs fail. If Mr. Royce's sales for November and December are up to the anticipated tonnage, he will certainly be the winner. Mr. Royce's record for collections has also been of the highest character—not having made a bad debt nor lost a dollar. The other eleven salesmen representing this agency have made gratifying showings for 1904.

Dodge & Day, engineers, Philadelphia, Pa., have been commissioned by the Conkling-Armstrong Terra Cotta Company to engineer the rebuilding and re-equipping of their plant at Wissahickon avenue and Juniata street, Philadelphia, lately destroyed by fire. The increase in the power plant of the Jeanesville Iron Works Company, Hazleton, Pa., also engineered by this firm, contemplates the installation of a 75-kilowatt 120-120-volt De Laval steam turbine generator. The equipping of the additional switchboard panel will be done by Walker Electric Company, Philadelphia, Pa. Dodge & Day will also install some 400 horse-power Westinghouse motors, ranging in speed from 5 to 150 horse-power, D. C., 230 volts, in the new plant of the Victor Talking Machine Company, Camden, N. J., as well as an Albro-Clem electric operated freight elevator having a lifting capacity of 7,600 pounds at a speed of 40 feet per minute.

The Wellman-Seaver-Morgan Company, Cleveland, Ohio, has been awarded by the Board of Trustees of the Sanitary District of Chicago, the contract for the turbine water-wheel equipment for the new power-house of the Chicago drainage canal near Joliet, Ill. The company has as competitors noted European and American builders of water-wheels. This is said to be the second largest installation of water-power equipment contracted for in the United States—the largest single water-power equipment previously contracted for being the one also built by the Wellman-Seaver-Morgan Company at Sault Ste. Marie, Michigan, for the power-house of the Lake Superior Power Company, and to consist, when completed, of 50,000 horse-power. The Chicago drainage canal power station equipment will comprise four 6,000 horse-power units of turbine wheels, which will be direct-connected to electric generators. There are also two exciter units of 600 horse-power each included in the contract. The contract will require about one year for completion.

The daily traffic service of the New York Subway contemplates the operation of two tracks carrying local trains at one-minute intervals and two more tracks with eight-car express trains at two-minute intervals. It will be appreciated that the safe handling of trains in such number and frequency offered problems in signal work almost unparalleled in railway history. A system has been worked out and applied which practically guarantees the safety of the traveling public. This is a development of the electro-pneumatic switch and signal system. In the operation of this system electricity and compressed air have joined forces; electricity being, as it were, the nerves and compressed air the muscles of the system. Electricity is the directing force; compressed air the actuating power. The air compressors were built by the Ingersoll-Sergeant Drill Company, of New York, and are a modification of standard type known as Class "E C." Nine compressor units have been installed and three more are under construction. Each compressor is connected by a Morse silent chain to a 35 horse-power Westinghouse direct-current motor, taking current from the lines at from 400 to 700 volts; motor and compressor units on a solid sub-base. At rated speed of 120 revolutions per minute each unit has a capacity of 215 cubic feet of free air per minute, compressed to 80 pounds pressure. The compressors are automatically controlled and regulated by the air pressure. Working pressure on the system is maintained constant within 5 pounds of the fixed standard. When receiver pressure falls below normal, a combination of electrical circuits operates to bring the compressor to speed with no load. When normal pressure is reached on the system the machine is unloaded and the motor cut out. Arrangement is also made whereby the starting and stopping of the unit also automatically starts and stops the flow of intercooling water and lubricating oils. Compressed air from these machines which are located in substations along the subway is distributed thru 2-inch pipe lines running the length of the system, and operates various signal mechanisms, pneumatic switches, automatic train stops, etc.

Manufacturers.

The Colusa (Cal.) Sugar Factory proposes to build shortly.

The Scioto Sign Company, Kenton, O., will double its capacity.

It is proposed to improve the city electric light plant at Paducah, Ky.

J. A. Johnston's planing mill, Beitler street, Pittsburg, Pa., has been burned.

The Bryden Horse Shoe Company, Catasauqua, Pa., is to enlarge its plant.

The New Bedford (Mass.) Extractor Company has filed plans for a new building.

Jesse Thompson, Sr., proposes the establishment of a cotton mill at Swainsboro, Ga.

Improvements are under way at Worth Bros'. Company's tube mill, Coatesville, Pa.

A machine shop is being built by the Rochester (N. H.) Foundry & Machine Company.

The cotton oil mill of the Jersey (Ga.) Oil Mill Company has been burned; ginnery saved.

The Specialty Weaving Company, Derby, Conn., is planning for another addition to its silk plant.

Sam H. Brubaker, of Indianapolis, Ind., tl inks of establishing a cold-storage plant at Nashville, Tenn.

Extensive additions to the Oregon Railroad & Navigation Company shops at Albina are being planned for.

The Indiana Brass & Iron Bedstead Company's factory, Marion, Ind., will be moved to Mooresville, Ind.

The A. Teachout Company, Cleveland, O., will build a factory addition for hardwood and interior finishing.

The factory of M. H. Daley, Charles City, Ia., manufacturer of disk harrows, barrel carts, etc., has been burned.

Varnish and dry color department buildings of the McLennan Paint Company, Buffalo, N. Y., have been burned.

The Gaynor & Mitchell Manufacturing Company, brass goods, Bridgeport, Conn., has bought a site for a new building.

A $2,000,000 packing company talks of locating at Houston, Tex., and the Business League is considering the matter.

Improvement of the Brightwood (Indianapolis), Ind., and other shops of the Big Four system is predicted as likely.

The Scranton (Pa.) Machine Works have purchased a large plot of ground and intend to erect an addition to their plant.

The plant of the Chautauqua Planter Company, manufacturer of hardware specialties, Jamestown, N. Y., has been burned.

The Joseph Horne Company, of Pittsburg, Pa., has been negotiating for the buildings at Latrobe for a shade factory and woolen mills.

H. S. Kerbaugh (Inc.), contractor, Philadelphia, Pa., and elsewhere, will, it is understood, build large repair shops at Marysville, Pa.

The plant of Samuel Lea's Sons, Philadelphia, Pa., finishers of cotton and woolen goods, will probably be moved to Charlotte, N. C.

The contract has been let for the carpentry, millwork and roofing of a large plant at New Castle, Del., for the Baldt Steel Company.

C. A. Curtis, of Wausau, Wis., and others of Ingram have organized the Ingram Lumber Company and will build a mill at Ingram.

The Baltimore & Belair (Md.) Electric Railway Company expects to build a power-house at the crossing of the Big Gunpowder River.

The National Enameling & Stamping Company has acquired 119 feet on Kinzie street, Chicago, Ill., and, it is said, may build a factory there.

The Odin Stove Manufacturing Company, Erie, Pa., manufacturer of gas stoves, etc., has broken ground for a two-story, 123x50-foot addition.

A two-story addition, 72x110 feet, has been planned for the plant of the Crane Company, manufacturer of pipe fittings and brass goods, Chicago.

Charles W. Harris, understood to be a Bay City, Mich., man, is arranging to start a factory in Peoria, Ill., to turn out launches, boats and skiffs.

The Dowden Manufacturing Company, potato harvesting machinery, Prairie City, Ia., will, it is said, erect an addition to the factory in the spring.

A new building to be erected at Rockland, Me., will be occupied in part by J. J. Shuman as a machine shop. He has purchased a machinery outfit.

The contract has been let to erect a 66x74-foot factory building for the Holmes, Booth & Haydens Company, manufacturer of brass, etc., Waterbury, Conn.

According to Burlington, Ia., information, a plant at Ferrodale (evidently a local place) is being, or expected to be, established to employ 1,000 persons.

The Marvel Furniture Company, Jamestown, N. Y., has purchased a piece of property, 200x240 feet, at East Jamestown, and will build a new plant.

The Hobart M. Cable Company, pianos and organs, Chicago and Freeport, Ill., is starting to build a $20,000 reed plant at Freeport. Machinery has been procured.

The sugar mill and machinery on the Port Hickey plantation at or near Port Hudson, La., have been burned. The owner is W. S. Slaughter, Jr., of Port Hudson.

The directors of the W. R. Jones (window) Glass Company, Morgantown, W. Va., whose plant was burned recently, have conditionally decided to rebuild at that point.

The Gem Knitting Mills, Columbia, Pa., have been purchased by A. R. Kreider & Bro., of Annville. The plant will be continued in operation and new machinery added.

The Irondale (O.) Mining Company and Irondale Coal Company have consolidated interests as the Ohio Coal & Fire Clay Company and expect to build a brick plant.

Plans have been filed for a new factory building for Geo. Haiss Manufacturing Company, to be erected at the corner of 141st street and Rider avenue, New York. It will be 54x100 feet, four stories and will be occu-

pied as a factory for the line of machinery made by this firm—coal-hoisting engines and clam-shell buckets, etc. The business has so increased as to necessitate an enlargement, which it is proposed to accomplish in part by the erection of this building, which will be supplemented by other buildings fronting on Canal Place.

The Gartland Foundry Company, one of the new industries secured by the Commercial Club, Terre Haute, Ind., has filed articles of incorporation with the Secretary of State. The capital stock of the company is $50,000, and the directors of the concern are Charles F. Gartland, John H. Schaumleffle and John C. Hasswell, of Marion, and Peter Gartland, of Terre Haute. The plant is completed. Gray-iron castings will be manufactured, and employment will be given to 100 men. Already the company has orders on hand amounting to $50,000.

The North & Pfeiffer Company has been organized, to engage in manufacturing at New Britain, Conn. The members include James Stanley North, who was president and manager of the New Britain Hardware Company, whose plant was recently sold out to Landers, Frary & Clark, and Christian Pfeiffer, who was foreman of Mr. North's other concern. The new company has located in the old plant of the New Britain Machine Company, in Chestnut street. It will manufacture motors and mechanical devices on which Mr. Pfeiffer has gotten out patents.

The Firth-Sterling Steel Company, projectiles, has been compelled to increase its plant at Demmler, Pa., on account of the rush orders placed by individuals supposed to represent the belligerent nations in the Orient. The contract has been let for a $100,000 addition, which is to be completed within thirty days. The United States has also increased its orders for projectiles for some unknown reason. The orders supposed to be for Russia and Japan are shipped to Germany, France and Italy. Previous to the war, it is said, no projectiles were shipped to these countries.

A large electrical supply factory is proposed to be established in Lima, O., next spring. The Wooley Electric Manufacturing Company has been incorporated at Columbus with a capital stock of $200,000, by Attorney James W. Halfhill, George V. Guyton and James E. Lowery, of Lima; W. B. Jack, of Wapakoneta, and L. G. Wooley, of Kenton. Mr. Wooley will soon become a resident of Lima. He is said to be the inventor of 360 electrical devices upon which he has secured patents, and to be one of six Americans who hold life memberships in the French Electrical Institute, of Paris.

The twine factory at the penetentiary, Topeka, Kan., which, we believe, was started a year or so ago to fight the trust, has been, according to the official report of the warden, a success. He says that the plant has made more than enough above the $150,000 appropriated to establish it, to pay the cost of the machinery, material and operating expenses; that the State has been able to furnish a good quality of twine to the farmers at a lower rate than they could have purchased it elsewhere. The plant will be enlarged and improved this winter, and the output next year greatly increased.

The Chas. Creighton Foundry Company, 155th street and Eighth avenue, New York city, having sold a large share of its stock to Chas. H. Thomas, at present superintendent of the Hay Foundry & Iron Works, Newark, N. J., has engaged him as manager, he to assume entire management of the concern commencing October 24, 1904. Mr. Thomas is president of the Associated Foundry Foremen, which acts in conjunction with the American Foundrymen's Association. He has been with the Hay Foundry for the past two years, prior to which he was for two years superintendent and manager of the Leland-Faulconer Manufacturing Company, Detroit, Mich.

The Lawrence (Mass.) Pump & Engine Company has been incorporated, with H. L. Mellor, president; F. A. Hall, treasurer, and Percy Hall, secretary. The corporation embraces the F. A. and P. Hall flyer and spindle works, also manufacturers of the Horrocks patent stop motion drum spooler with Hall's improved traverse, and in addition will make a specialty of improved centrifugal pumps and vertical steam engines. It has taken additional space and will install improved machinery used in the manufacture of engines and pumps. The president of the new corporation, H. L. Mellor, was for eight years with the Lawrence Machine Company, first as draftsman and later as superintendent, and under his management the business was greatly increased.

New Catalogs.

Spaulding Print Paper Company, Inc., Boston, Mass. Pamphlet illustrating and describing "Federal" blueprinting machines. 6x9.

H. W. Caldwell & Son Company, Chicago, Ill. Caldwell double-disk friction clutches and friction clutch pulleys. Illustrated. 6x9, pp. 32, paper.

American Blower Company, Detroit, Mich. Catalog No. 171, illustrating and describing "A. B. C." vertical engines, type "A." 7x8¾, pp. 23, paper.

Colburn Machine Tool Company, Franklin, Pa. Pamphlet describing the 72-inch, widened pattern vertical boring mill built by this company. Illustrated. 6x9, paper.

The Rand Drill Company, 128 Broadway, New York. Circular No. 14, showing pneumatic hammers, piston air drills and other "Imperial" pneumatic tools. 9x12, pp. 7.

Pawling & Harnischfeger, Milwaukee, Wis. Special catalog showing sizes and types of horizontal drilling and boring machines made by this company. Illustrated by half-tones. 6x9¼, pp. 16, paper.

The Ingersoll-Sergeant Drill Company and the Westinghouse Traction Brake Company, 26 Cortlandt street, New York, have jointly issued a pamphlet describing the storage air brake system of the St. Louis Transit Company. Illustrated. 6x9, pp. 14, paper.

Landis Tool Company, Waynesboro, Pa. Self-contained grinding machines arranged for electric or belt drive. Illustrated pamphlet. 6x9, pp. 8, paper. Circulars of No. 1 universal grinding machine, No. 3 universal grinding machine and No. 11 plain grinding machine with automatic feeds. 6x9.

The Cleveland Stone Company, Cleveland, Ohio. "Grounds for a Good Grindstone" is the title of a bright little booklet which points out the difference between good grindstones and bad grindstones, and which tells of the different variety and grades of grindstones, for different services, supplied by this company. 3¼x6, pp. 8, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Addressing machines for office use. Joline & Co., 123 Liberty St., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light mach'y to order; model work; rubber molds. J. W. Weir, Bridgeport, Conn.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

A practical book, "Dies and Diemaking." post paid $1. J. L. Lucas, Bridgeport, Conn.

Machinists—Send 5 cents for table of standard pipe and tapping sizes. E. E. Meyer, Allegheny, Pa.

Steel name and monogram name stamps; diesinking; write for estimates. J. L. Lucas, Bridgeport, Conn.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Write for price on only machine shop, boiler shop and foundry in Black Hills. J. C. O'Donnell, Deadwood, S. D.

Auto. machinery of all kinds designed and built; hardened and ground work, flat or circular. Wiebking, Hardinge & Co., Chicago.

A few thoroughly investigated, high-grade machinery companies desire active partners. Will put you in touch without expense. Business Opportunity Co., 1 Union Square, New York.

Want partner with few thousand dollars to invest in the manufacture of three patented tool specialties which sell on merit with duplicate orders; large profit. Box 506, AMERICAN MACHINIST.

An old-established English firm of iron and open hearth steel founders, having machine shops, desire to manufacture and assemble machinery or tools for European markets for American makers. Address Wm. Towler, Globe Foundry, Leeds, England.

For Sale.

Miami 5 and 10 H.-P. gas engines for sale: perfect condition; big bargain; first offer takes them. E. R. Carroll, 2813 Hunington ave., Newport News, Va.

For Sale—1 Farrel Foundry hydraulic pump and press; 800 tons; cost $1,950; will sell very reasonable; perfect condition. H. M. Crowell Mfg. Co., 6th ave. and 13th st., Newark, N. J.

For Sale—1 Cleveland automatic screw machine, ⅜ in. to ½ in.; 1 American gas furnace, 2 enameling ovens. The Durbrow & Hearne Manufacturing Company, 12 Wooster st., New York City, N. Y.

I can sell your machine shop (or other business), with or without real estate, no matter where it is or what it is worth. Send description, state price, and learn how. W. M. Ostrander, 111 North American Bldg., Philadelphia.

Business for Sale.—Complete high-pressure steam fitting plant; Staten Island; going concern; modern machinery, tools, patterns, supplies; worth $30,000; if taken immediately, $12,500; opportunity of lifetime. Joab Banton, Atty., 35 Nassau st., New York.

Structural Iron or Bridge Works.—We offer the entire plant of the Wabash Bridge & Iron Works, Wabash, Indiana, including land, buildings and complete equipment of machinery, at about one-third of its original cost. This is an unusual opportunity for a bridge or structural iron man to get a modern plant at a bargain. The machines alone are worth what we ask for the entire property. Wm. A. Reade & Co., 402 Chamber of Commerce Bldg., Cleveland, Ohio.

Fire Sale—Bargain Prices.—Bench lathes: forges, $6.90; Yankee calipers; dividers, inside, outside, 3, 4, 5 in., 35c.; steel scales, 4 to 9 in., 25c.; 13 Jennings bits in canvas roll, ¼ to 1 in., regular price $3, our price $2.15; Besly disc grinder; screw cutting lathe, $40; three-dollar breast drills, $2; Swiss and Stubs files, 4 to 8 in., retail 50c. to 75c., our price 20c.; combination squares, 12 in., complete, hardened blade, $1.10; combined drill gauge and block, hold 60 drills, retail $5, our price $3.75. Call before assortment is broken. Frasse Co., 38 Cortlandt st., New York.

For Sale—Four Watts-Campbell Corliss engines, 24x56; 400 horse-power at 100 lbs. steam pressure; 70 revolutions per minute; flywheel—diameter 20 ft., face 46 in.; condition first class. One double Watts-Campbell Corliss engine, 18x42; 250 horse-power at same pressure; 91 revolutions per minute; flywheel—diameter 16 ft., face 32 in. One N. Y. Safety engine, 12x12; 75 horse-power at same pressure; 250 revolutions per minute; 2 belt wheels, 4½ ft.; diameter 17½ in. and 13 in. face. Will sell singly. Can be seen in New York city by addressing The United Electric Light & Power Company, 1170 Broadway, New York city.

Machine Shop and Foundry.—We offer a complete machine shop and foundry, fully equipped with modern machinery; has five lathes, four planers, including 48" x 48" x 10' Pond, three drills, shaper, milling machine, gear cutter, keyseater, 30 H.-P. gas engine, lighting dynamo and many other machines. Patterns for a complete and profitable line of standard machines. Plenty of jobbing work. The foundry has complete equipment. Located in a good Ohio city. Price less than one-half original cost, and will be sold on easy terms. Business is improving rapidly. Next year will see all the shops full of